

Stroke epidemiology and in-hospital mortality in a Mexico City hospital: a prospective two-years study

Epidemiología y mortalidad hospitalaria por evento vascular cerebral en un hospital de la Ciudad de México: estudio prospectivo de 2 años

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Abstract

Objective: To describe patient characteristics, case fatality rate, and assess predictors of in-hospital acute ischemic (IS) or hemorrhagic stroke (HS) mortality. **Method:** Adult patients with confirmed stroke were recruited from January 1st, 2018 to December 31st, 2019. Data collect included: demographic and laboratory characteristics, risk factors, and clinical outcome. A binary logistic regression model with relative risk and 95% confidence interval was performed. **Results:** A total of 172 patients were recruited; IS was present in 78.5% of patients. The mean of age was 75.27 ± 11.44 years in IS group and 71.62 ± 11.72 years in HS group. Hypertension was present in > 70% of patients in both groups; the in-hospital case fatality rate was 15.5% for IS and 21.5% for HS. Severe NIHSS score (> 13) was significantly associated with in-hospital mortality in both stroke types. **Conclusions:** Hypertension was the most common risk factor in patients with stroke. The in-hospital case fatality rate was lower to previously reported in Mexico. Nevertheless, it remains high compared to reported in developed countries. NIHSS scale was the strongest predictor of mortality. There is a need to develop more effective stroke management services in Mexico.

Keywords: Ischemic Stroke. Hemorrhagic stroke. Risk factors. In-hospital Mortality. México.

Resumen

Objetivo: Describir las características y los factores pronósticos para mortalidad intrahospitalaria en pacientes con diagnóstico de evento vascular cerebral isquémico (EVCi) o hemorrágico (EVCh). **Método:** Se incluyeron 172 pacientes en el periodo del 1 de enero de 2018 al 31 de diciembre de 2019. Se recabaron características demográficas, de laboratorio y factores de riesgo. Se realizó un análisis de regresión logística binaria calculando el riesgo relativo y el intervalo de confianza al 95% para identificar las variables asociadas a la mortalidad. **Resultados:** El 78.5% de los pacientes presentaron EVCi. La media de edad fue de 75.27 ± 11.44 años en el EVCi y de 71.62 ± 11.72 años en el EVCh. El antecedente de hipertensión se encontró en más del 70% de los pacientes en ambos tipos de EVC. La mortalidad hospitalaria fue del 15.5% en el EVCi y del 21.5% en el EVCh. Una puntuación grave (> 13) en la escala NIHSS (National Institutes of Health Stroke Scale) presentó asociación significativa con la mortalidad en ambos tipos de EVC. **Conclusiones:** La hipertensión fue el factor de riesgo más común. La mortalidad hospitalaria fue menor que lo reportado previamente en México. La escala NIHSS fue el mejor predictor de mortalidad. Es necesario desarrollar estrategias para mejorar la atención de los pacientes con EVC en México.

Palabras clave: Evento vascular cerebral isquémico. Evento vascular cerebral hemorrágico. Factores de riesgo. Mortalidad hospitalaria. México.

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Introduction

According to the results of the *Global Burden Disease* study (2020), during the year 2019, 3.33 million deaths associated with a stroke in men and 3.22 million in women occurred worldwide. Additionally, in the same year, stroke was the cause of 143 million disability-adjusted life years lost (DALYs). Currently, stroke is the second leading cause of DALYs in the world after coronary heart disease¹. However, substantial geographic differences in incidence, DALYs lost, and mortality associated with stroke have been documented, with a greater impact in low- and middle-income countries²⁻⁴.

Stroke is the leading cause of death and disability in Latin America³. Mexico is a middle-income country experiencing the epidemiological transition, with a progressive increase in the prevalence of chronic non-communicable diseases and cardiovascular risk factors^{5,6,7}. In 2010, stroke was the fourth leading cause of death in the general population in Mexico⁸ and the third leading cause in people over 65 years of age⁹. In 2012, mortality from ischemic stroke (IS) was 3.92 per 100,000 inhabitants, and 7.62 per 100,000 for intracerebral hemorrhage. Additionally, Mexico City is among the states with the highest mortality rates for stroke¹⁰.

On the other hand, it has been pointed out the lack of information on epidemiological data related to stroke in many countries, particularly in developing nations². In fact, in Mexico there are limited publications on in-hospital mortality associated with stroke.

The aim of the present study was to describe the characteristics and risk factors in patients admitted to a hospital in Mexico City with a diagnosis of stroke, as well as to identify prognostic factors for in-hospital mortality.

Method

This prospective study was conducted in the period from January 1, 2018 to December 31, 2019, and included adult patients admitted to the internal medicine area of the Iztacalco General Hospital of the Mexican Institute of Social Security in Mexico City, with the diagnosis of hemorrhagic stroke (HS) or acute IS.

Stroke was defined according to the World Health Organization criteria as the sudden development of usually focal neurological symptoms lasting at least 24 hours. Patients with subarachnoid hemorrhage, intracranial hemorrhage of traumatic origin, and arteriovenous

malformations were excluded. Patients receiving thrombolysis treatment were not included because they are referred for care.

The following data were collected at the time of patient admission: age, sex, weight, height, blood pressure, and score on the NIHSS scale (National Institutes of Health Stroke Scale). The risk factors for stroke considered were hypertension, diabetes, cardiovascular disease, chronic kidney disease, and smoking. Initial laboratory data included white blood cell and platelet counts, hemoglobin, creatinine, blood urea nitrogen, and electrolytes. Body mass index was calculated by dividing weight in kilograms by height in square meters. All patients underwent computed tomography (CT) to distinguish between IS and HS; if no ischemic area was evident on CT, magnetic resonance imaging (MRI) was performed.

The study was conducted in accordance with the Declaration of Helsinki and was approved by the institutional ethics and research committees. All patients signed their informed consent. In cases of decreased alertness or severe aphasia, the patient's caregiver or close relatives gave consent.

Statistical analysis was performed using the SPSS statistical package (Statistical Package for the Social Sciences) version 21. The distribution of quantitative data was determined using the Kolmogórov-Smirnov test; data with parametric distribution are presented as mean and standard deviation (SD), and those with non-parametric distribution as median and interquartile range. Categorical data are shown as frequency and percentage. Differences between groups for quantitative variables were determined using Student's t test for unpaired data or the Mann-Whitney U test, depending on their distribution; for categorical variables, the χ^2 test or Fisher's exact test were applied, as appropriate. A value of $p < 0.05$ was considered statistically significant. To identify variables predictive of in-hospital mortality, a binary logistic regression analysis was performed, in which variables with statistically significant association in the univariate analysis were included. For this analysis, continuous variables were dichotomized using the values clinically accepted as normal as the cut-off point, and the relative risk (RR) and 95% confidence interval (95%CI) were calculated to assess the strength of the association of each variable.

Results

Based on symptoms, clinical signs, and CT or MR images, 172 patients with a diagnosis of stroke were

hospitalized in the study period: 135 (78.5%) with IS and 37 (21.5%) with HS. Table 1 shows the baseline characteristics of the patients according to the type of stroke. The mean age at presentation was 75.27 years (SD: ± 11.44) in patients with IS and 71.62 years (SD: ± 11.72) in patients with HS; 60% of the patients were female in the IS group and 43.2% in the HS group.

Arterial hypertension was the main risk factor in both groups: 76.3% in the IS group and 73% in the HS group. Other risk factors were diabetes, smoking, and atrial fibrillation. 46.5% of patients had arterial hypertension and diabetes (44.4% in the IS group and 54% in the HS group).

There were 30 in-hospital deaths during the study period: 22 in the IS group and 8 in the HS group. The mortality rate was 15.5% and 21.5%, respectively. Table 2 shows the baseline characteristics of patients who died and of those who survived according to the type of stroke. In both groups, patients who died were older and had higher NIHSS scores compared to those who survived ($p < 0.01$ in both groups). Additionally, patients who died in the IS group had higher white blood cell counts and lower serum sodium levels. No association was found between the rest of the variables and mortality.

Binary logistic regression analysis (Table 3 and Fig. 1) showed that, in both groups, the presence of a severe NIHSS score (> 13) had a statistically significant association with in-hospital mortality (for IS, RR: 24.36, 95%CI: 5.8-102.26, $p < 0.0001$; for HS, RR: 9.16, 95%CI: 1.14-73.23, $p = 0.037$). In addition, in patients with IS, the number of white blood cells $> 10,000$ cells/mm³ (RR: 7.56, 95%CI: 1.94-30.3, $p = 0.004$) and age > 70 years (RR: 5.17, 95%CI: 1.07-26.64, $p = 0.049$) presented statistically significant association with in-hospital mortality.

Discussion

This prospective study was conducted with the purpose of identifying the prevalence of stroke subtypes, risk factors, and in-hospital mortality in the context of a public general hospital. There is great heterogeneity in the methodology used in epidemiological studies on stroke, both in Mexico and in other countries, especially with respect to the population studied (hospitalized patients, community or population-based studies) and follow-up time (survival during hospitalization, at 28 days, at 1 year or even longer). Therefore, comparison of the results is difficult, but some data are consistent despite the different methodology.

Table 1. Patient characteristics according to the type of stroke

Variable	Ischemic stroke	Hemorrhagic stroke
Female sex, n (%)	81 (60)	16 (43.2)
Age, years	75.27 (± 11.44)	71.62 (± 11.72)
NIHSS Scale	12 (± 6.7)	13 (± 6.4)
Systolic blood pressure, mmHg	137.96 (± 26.39)	163.49 (± 29.4)
Diastolic blood pressure, mmHg	77.61 (± 13.07)	90.35 (± 15.82)
Hemoglobin, mg/dl	14.4 (12.6-15.5)	15.1 (13.1-15.8)
White blood cells, cells/mm ³	7.7 (6.6-9.9)	8.9 (7.35-11.9)
Glucose, mg/dl	125 (102-164)	159 (108-236)
Sodium, mEq/l	137.5 (± 4.33)	136.4 (± 5.1)
Creatinine, mg/dl	0.8 (0.7-1.2)	0.9 (0.7-1.28)
Diabetes, n (%)	72 (53.3)	21 (56.8)
Hypertension, n (%)	103 (76.3)	27 (73)
Smoking, n (%)	45 (33.4)	18 (48.6)
Atrial fibrillation, n (%)	23 (17)	4 (10.8)

NIHSS: National Institutes of Health Stroke Scale.

Data are presented as mean $\pm$ standard deviation, median with interquartile range or frequency.

In our population, the most frequent risk factor was hypertension for both types of strokes, followed by diabetes, as has been reported in Mexico¹¹⁻¹⁴ and in low- and high-income countries¹⁵⁻¹⁷. However, we found a higher prevalence of both conditions compared to what was previously reported in Mexico. These findings could be partly explained by the older age of our patients compared to previous studies (53-68 years) and by the increased prevalence of hypertension in the country.

The findings highlight the importance of developing effective strategies for the diagnosis and management of hypertension. Although many risk factors for stroke, including chronic diseases such as diabetes and hypertension, are more prevalent in high-income countries^{18,19}, differences in access to medical treatment may explain the higher morbidity and mortality in low- and middle-income countries^{20,21}. In fact, in Mexico it has been reported that 40% of people with hypertension were unaware of their diagnosis and that only 45.6% of those who were aware of their condition had it under control²².

As previously mentioned, a wide range of stroke mortality has been reported in different regions and countries of the world, with the highest rates in developing countries²³⁻²⁶.

Table 2. Patient characteristics by mortality and type of stroke

Variable	Ischemic stroke			Hemorrhagic stroke		
	Mortality (n = 22)	Survival (n = 113)	p	Mortality (n = 8)	Survival (n = 29)	p
Female sex, n (%)	11 (50)	70 (61.9)	> 0.05	3 (37.5)	13 (44.8)	> 0.05
Diabetes, n (%)	11 (50)	61 (53.9)	> 0.05	5 (62.5)	16 (55.1)	> 0.05
Hypertension, n (%)	16 (72.7)	87 (76.9)	> 0.05	6 (75)	21 (72.4)	> 0.05
Age, years	79.91 ($\pm$ 7.81)	74.36 ($\pm$ 11.84)	< 0.05	80.5 ($\pm$ 5.26)	69.17 ($\pm$ 11.87)	< 0.05
NIHSS	21 ($\pm$ 6.7)	11 ($\pm$ 5.2)	< 0.05	19 ($\pm$ 5.5)	11 ($\pm$ 4.86)	< 0.05
Hemoglobin, mg/dl	14.85 (12.9-15.92)	14.3 (12.5-15.3)	> 0.05	16.4 (11.62-15.4)	15.2 (13.45-16.05)	> 0.05
White blood cells, cells/mm ³	9.95 (6.77-11.74)	7.6 (6.45-9.2)	< 0.05	9.8 (6.0-12.52)	8.9 (7.35-11.85)	> 0.05
Glucose, mg/dl	128 (103-161)	125 (100-167.5)	> 0.05	190 (85.75-222)	155 (112.5-239)	> 0.05
Sodium, mEq/l	139.55 ($\pm$ 3.47)	137.19 ($\pm$ 4.39)	< 0.05	135.73 ($\pm$ 6.61)	136.64 ($\pm$ 4.8)	> 0.05

NIHSS: National Institutes of Health Stroke Scale.

Data are presented as mean $\pm$ standard deviation, median with interquartile range or frequency.**Table 3. Prognostic factors for in-hospital mortality by type of stroke**

Variable	Ischemic stroke			Hemorrhagic stroke		
	RR	p*	95%CI	RR	p*	95%CI
NIHSS > 13	24.36	0.0001	5.83-102.26	12.75	0.013	1.7-95.1
Age > 70 years	5.17	0.049	1.07-26.64	7.36	0.106	0.6-83.1
White blood cells > 10,000 cells/mm ³	7.62	0.004	1.94-29.83	-	-	-
Na < 135 mEq/l	4.47	0.181	0.498-40.31	-	-	-

95%CI: 95% confidence interval; NIHSS: National Institutes of Health Stroke Scale;

RR: relative risk.

*Binary logistic regression model.

As expected, the risk of death associated with HS was higher than that of IS. The in-hospital mortality rate in our study was lower compared to other studies conducted in Mexico: in the BASID study it was 29% for IS and 48% for HS²⁷, while in the RENAMEVASC study it was 17.5% for IS and 31.4% for HS¹¹. The mortality rate in our patients with IS was more similar to the 15% reported in the PREMIER study¹².

A decrease in the age-adjusted mortality rate for all types of strokes in Mexico has been documented in the period from 1980 to 2012⁷. Studies in Brazil have also documented a decrease in mortality at 28-30 days over a similar period, particularly for HS²⁸⁻³⁰. In fact, the National Institute of Neurology and Neurosurgery, a benchmark center specializing in the care of neurological patients in Mexico City, has reported the lowest

in-hospital mortality rate, as well as the greatest reduction in mortality in the country^{13,14}. Despite this reduction, mortality remains high when compared to that reported in developed countries. This fact emphasizes the need to improve stroke prevention and care in order to reduce the mortality gap between developed and developing countries^{31,32}. However, even in developed countries, differences in mortality among hospitals and towns have been described³³, and these differences have been associated with the type of care that patients with stroke receive, such as access to endovascular therapy or specialized care units for patients with stroke. In fact, the lowest mortality rates have been reported in hospitals with such units^{17,34,35}. Therefore, access to this type of care could decrease mortality in patients with stroke.

Finally, our findings suggest that stroke severity as assessed by the NIHSS scale is a good predictor of mortality from both IS and HS, as has been consistently reported in the literature³⁶⁻³⁹. In addition, advanced age^{11,39,40} and elevated white blood cell count³⁹ were also significantly associated with mortality in patients with IS. These predictors of mortality could be useful in the decision to assign a high-risk patient to more advanced care.

The present study has some strengths: its prospective design, the 2-year period, and complete follow-up during hospitalization are the main ones. We are aware that our results are limited by the relatively small population of a single study center. Furthermore, our data may not represent overall mortality attributable to stroke because we only analyzed patients admitted

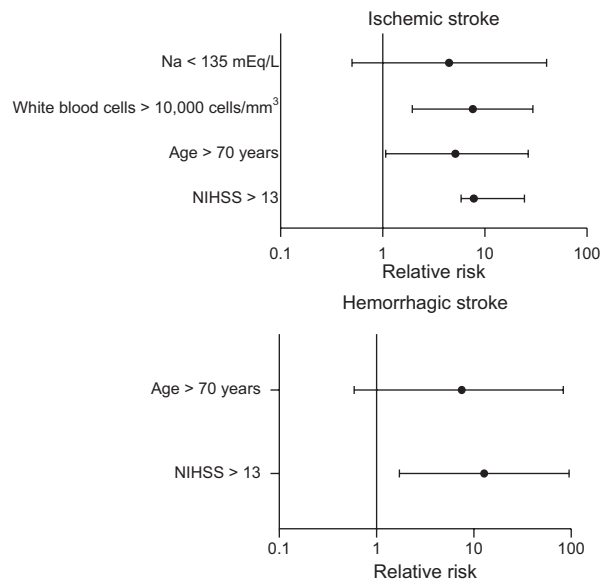


Figure 1. Forest plot showing the multivariate relative risk for in-hospital mortality for both types of strokes. Variables with significant differences ($p < 0.05$) in the univariate analysis were included in the analysis. NIHSS: National Institutes of Health Stroke Scale.

to the hospital, excluding those who may have died in the emergency department and those referred to other hospitals for interventional therapies. However, our results are comparable with those of other studies in Mexico and other countries, and therefore we consider them to be consistent with changes in mortality trends at the regional and national levels.

Conclusions

In a population admitted to a general hospital in Mexico City with a diagnosis of stroke, the main risk factor was hypertension, followed by diabetes. A modest decrease in the in-hospital mortality rate was documented compared to that reported in other studies in Mexico. However, this decrease is less than that documented in specialized centers in Mexico and in developed countries. The NIHSS scale was identified as a predictor of mortality in both types of strokes. It is important to develop more effective stroke care and prevention strategies in Mexico.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

Ethical disclosures

Protection of people and animals. The authors declare that no experiments were carried out on humans or animals for this research.

Data confidentiality. The authors declare that they have followed their center's protocols on the publication of patient data.

Right to privacy and informed consent. The authors have obtained the informed consent of the patients and/or subjects referred to in the article. This document is in the possession of the corresponding author.

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