

ORIGINAL ARTICLES

Trends in the seeking of emergency service for ischemic stroke and its risk factors during the COVID-19 pandemic, a study from Taiwan

¹Yi Te Tsai MD, ²Yachung Jeng PhD, ²Hsiu-Hsi Chen PhD, ¹Kai Chieh Chang MD

¹Department of Neurology, National Taiwan University Hospital Yunlin Branch, Yunlin, Taiwan;

²Institute of Epidemiology and Prevention Medicine, College of Public Health, National Taiwan University, Taipei, Taiwan

Abstract

Background & Objectives: COVID-19 may influence the health seeking behavior of acute ischemic stroke patients. This study aimed to determine the characteristics of the patients who visited the emergency room in a centre designated for stroke care in Taiwan. **Methods:** This was a retrospective database-based study comparing the severity of ischemic stroke, intracerebral hemorrhage (ICH), and risk factors of patients seen between 2019 and 2020 in the National Taiwan University Hospital Yunlin Branch. Patients with or without thrombolysis therapy were analysed. **Results:** The median NIHSS of ischemic stroke patients were lower in 2019 than in 2020 ($p = 0.015$). The difference was seen in non-thrombolysis patients (2019: 3[1-6] vs. 4 [2-7.5], $p = 0.012$) but not in thrombolysis patients. The frequency of minor stroke was higher in 2019 (45.1%) than in 2020 (37.9%, $p = 0.038$). The discharge mRS was lower overall ($p = 0.004$) and in non-thrombolysis patients (0.003), but not in thrombolysis patients in 2019. As for the ICH patients, the severity of ICH score ($p = 0.021$) and discharge mRS ($p = 0.001$) were also lower in 2019. The frequencies of risk factors of stroke were higher in 2019 than in 2020, including smoking (24% vs. 18.2%, $p = 0.046$), alcohol (11.9% vs. 7.5%, $p = 0.039$), hypertension (72.9% vs. 66.2%, $p = 0.039$), history of stroke (16.5% vs. 11.6%, $p = 0.047$), and atrial fibrillation (11.9% vs. 7.5%, $p = 0.039$).

Conclusions: This study in Taiwan revealed a decline in the willingness to seek emergency services under the influence of COVID-19 among patients with lower stroke severity, especially those with more risk factors.

Keywords: COVID-19, ischemic stroke, emergency, risk factors

INTRODUCTION

As the COVID-19 has caused devastating global impacts with millions of deaths worldwide, Taiwan has reported a relatively lower number of confirmed cases.

Emergency medicine management, such as for ischemic stroke, may have been affected by the pandemic. The numbers of patients hospitalized for acute ischemic stroke, transient ischemic attack, and intracerebral hemorrhage in Germany has declined as the pandemic has progressed.¹ The rates of thrombolysis and thrombectomy may decrease², and data regarding quality control, such as time to image, and time to puncture

may also deteriorate.³⁻⁵ In Taiwan, one previous report suggested that with the onset of the pandemic, the number of hospital admissions for stroke decreased, while thrombolysis increased significantly.⁶ These findings may suggest a differences in the attitude of the populations in seeking emergency services, while the severity of stroke remained the same.

Although Taiwan has been relatively unaffected by the pandemic, the fear of being infected may still affect patients' willingness to visit hospitals. In this study, we examined the stroke database of our hospital, with the aim to determine the health seeking behaviour of our patients as regards to

Address correspondence to: Kai Chieh Chang, MD, Department of Neurology, National Taiwan University Hospital Yunlin, No.579, Sec. 2, Yunlin Rd., Douliu City, Yunlin County, 64041, Taiwan. Email: b94401022@ntu.edu.tw

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ischemic stroke, comparing the data before and after the onset of the pandemic.

METHODS

This retrospective database study was approved by the ethics committee of National Taiwan University Hospital (202004035RINA) and was conducted in accordance with the principles of the Declaration of Helsinki.

Participants

We collected the patients’ demography data from the stroke database of National Taiwan University Hospital, Yunlin Branch, which is a secondary referral hospital in Yunlin County. Patients diagnosed as having ischemic stroke and intracerebral hemorrhage (ICH) during the period from January 1, 2019 to December 31, 2020, were included in the analysis. Diagnoses were made by qualified neurologists or neurosurgeon, with or without corresponding evidence from neuroimages.

Data collection

We collected patients’ data, including their age, sex, occupation, and risk factors (smoking habit, alcohol use, hypertension, diabetes mellitus, and history of stroke). These risk factors were counted only if they were reported by the patient before they visited the ER. Data related to stroke included whether thrombolysis was administered, door-to-needle time and the presence of hemorrhagic transformation (if the patient received thrombolysis), initial National

Institute of Health Stroke Scale (NIHSS) score, ICH score, and modified ranking scale (mRS) on the day of discharge. Minor stroke was defined as an NIHSS score of ≤ 3 .⁷ Total numbers of ER visits were retrieved from the quality control system of our hospital.

Statistical methods

Patient age and NIHSS score are expressed as the median (interquartile range [IQR]) because they did not exhibit normal distribution on the Shapiro–Wilk W test. Categorical variables are expressed as numbers and percentages. The 95% CIs for monthly visiting counts were calculated using normal approximation method, which is adequate for large mean counts. Comparisons of demographic characteristics, risk factors, and stroke-related data were made between 2019 and 2020. The Mann-Whitney U test was used for assessing continuous variables, and Pearson’s chi-squared test was used for categorical variables. A P value of < 0.05 was considered indicative of a significant difference between the campaigns. The data of patients with and without thrombolysis therapy were subjected to subgroup analyses.

RESULTS

The number of ER visits made by patients was 46,791 in 2019 and 39,016 in 2020 respectively (Figure 1). This number reached a nadir that corresponded with the peak number of COVID-19 diagnoses in Taiwan. The number of patients who visited ER who were diagnosed as having ischemic stroke was 479 (1.02%) in 2019 but

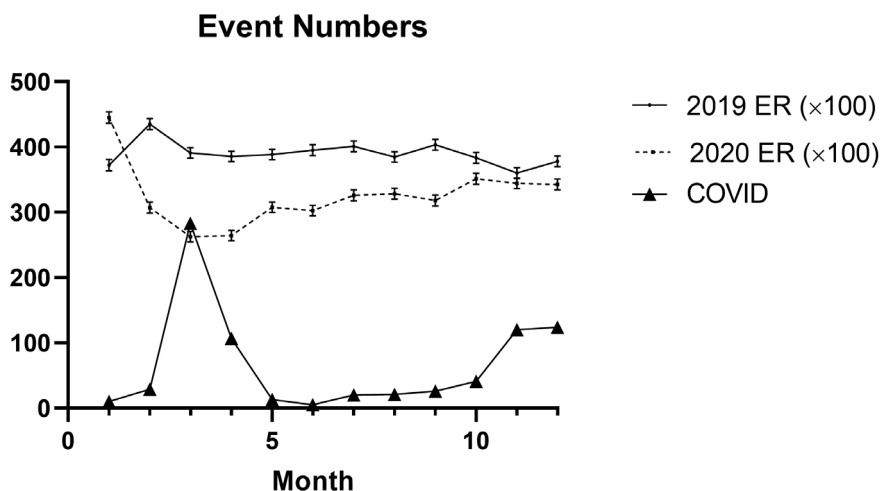


Figure 1: Numbers of total emergency visits in the National Taiwan University Hospital Yunlin Branch and diagnosis of COVID-19 in Taiwan

only 346 (0.88%) in 2020 ($P = 0.041$; Table 1). The median (IQR) age of patients with ischemic stroke was 72 (63-80) years in 2019 and 73 (64-82) years in 2020. Of those patients, the number who received thrombolysis with tissue plasminogen activator was 64 (13.4%) in 2019 and 58 (16.8%) in 2020. The number of patients who were diagnosed as having ICH was 139 and 116 in 2019 and 2020 ($P = 0.995$), respectively. The median (IQR) age was 68 (55-79) in 2019 and 64 (54.5-77) years in 2020. Both age and sex had no significant differences between two years.

Regarding ischemic stroke severity (Table 1), the median (IQR) patient NIHSS score was lower in 2019 (4 [2-8]) than in 2020 (5 [2-8], $P = 0.015$). This difference was observed among patient who did not receive thrombolysis (2019: 3[1-6] vs. 2020: 4 [2-7.5], $P = 0.012$) but not among those who received thrombolysis. The frequency of minor stroke was also higher in 2019 (45.1%) than in 2020 (37.9%, $P = 0.038$). Moreover, the mRS at discharge was lower in the overall ischemic stroke patient population ($P = 0.004$) and in patient who did not receive thrombolysis ($P = 0.003$) in 2019, but not in those who received thrombolysis. The door-to-needle time and hemorrhagic transformation rate were similar between 2019 and 2020. In patients with ICH (Table 2), the severity was also higher in 2020 in consideration of higher portion in ICH score 2-4 ($P = 0.021$). The mRS at discharge was also higher in 2020 ($P = 0.001$).

The prevalence of risk factors for patient diagnosed as having ischemic stroke were higher in 2019 than in 2020 (Table 3), including smoking (24% vs 18.2%, $P = 0.046$), alcohol (11.9% vs. 7.5%, $P = 0.039$), hypertension (72.9% vs. 66.2%, $P = 0.039$), history of stroke (16.5% vs. 11.6%, $P = 0.047$), and atrial fibrillation (11.9% vs. 7.5%, $P = 0.039$) (Table 2). In the subgroup analysis, the risks in 2019 and 2020 were similar among patients who received thrombolysis. Among patients who did not receive thrombolysis, the prevalence of risk factors was also higher in 2019, including smoking (25.1% vs. 16.7%, $P = 0.008$), alcohol (12% vs. 6.9%, $P = 0.026$), hypertension (73% vs. 66%, $P = 0.045$), and atrial fibrillation (11.6% vs. 6.6%, $P = 0.027$). Among patients with ICH, only smoking prevalence was higher in 2020 (11.7% vs. 21.1%, $P = 0.032$).

DISCUSSION

In this study, we examined data in the stroke database of our hospital. The number of ER visits

due to stroke decreased from 2019 to 2020 under the impact of COVID-19. However, the number of patients who received thrombolysis was similar, and the major reduction was attributable to the decrease in the number of patients who milder stroke. Patients with higher stroke risk factors, including smoking, alcohol, hypertension, history of stroke and atrial fibrillation were less likely to visit ER in 2020, the year when the COVID-19 pandemic began. The ICH patients who were less severe were also less likely to visit ER in 2020.

Wester *et al.* suggested that gradual onset and mild neurological symptoms may delay the time to admission after stroke.⁸ One study reported that in Hong Kong, the number of ER admissions among patients with transient ischemic attack decreased significantly after the beginning of the pandemic.⁹ In Taiwan, only a trend of reduced stroke severity among patients admitted to hospitals could be observed, possibly due to insufficient statistical power.⁶ In our study, patient NIHSS scores, patient mRS were all higher, and the proportion of patients with minor stroke were lower in 2020, thus providing more evidence indicating that people's willingness to seek emergency services for stroke has decreased since the beginning of the COVID-19 pandemic. The finding that the number of admissions among patients who received thrombolysis was relatively unaffected by the pandemic, considered in combination with the stability of the quality control data, suggests that the decrease in number of ER visits for stroke is unrelated to the lack of medical resources in Taiwan. Of the ICH, previous study did not found reduction of admissions due to hemorrhagic cerebrovascular disease, but patients also had delayed emergency rooms visiting, which resulted in a worse clinical outcome.¹⁰

In this study, we found that people who had more vascular risk factors, including smoking, alcohol, hypertension, atrial fibrillation, or history of stroke was less willing to visit ER for stroke in 2020 than in 2019. A study conducted in Hong Kong reported no significant difference in the risk factors among patients admitted to hospital for stroke.⁹ Another study suggested that the total number of risk factors may not have a positive correlation with risk perception.¹¹ Furthermore, stroke knowledge has been shown to be the poorest in population with the highest risk.^{12,13} The inverse relationship may be due to patient's lack of concern for their health.

This study's retrospective design and inclusion of only one stroke center may limit the generalizability of the findings. However, because

Table 1: Comparison of ischemic stroke-related data between 2019 and 2020

	All			Thrombolysis			Non-thrombolysis		
	2019 (n=479)	2020 (n=346)	p-value	2019 (n=64)	2020 (n=58)	p-value	2019 (n=415)	2020 (n=288)	p-value
ER visiting, n	46791	39016							
Stroke/ER, %	1.02	0.88	0.041*						
Age, year [IQR]	72 [63-80]	73 [64-82]	0.12	70 [62.5 - 77.5]	71 [65-82]	0.2	73 [63-80]	74 [64-82]	0.21
sex (male %)	56.4	57.2	0.81	60.9	62.1	0.9	55.7	56.3	0.88
NIHSS, median [IQR]	4 [2-8]	5 [2-8]	0.015*	9 [5-18]	7.5 [5-13]	0.26	3 [1-6]	4 [2-7.5]	0.012*
Minor stroke, %	45.1	37.9	0.038*	1.6	0	0.34	51.8	45.5	0.099
MRS, n(%)			0.004*			0.79			0.003*
0	82 (17.1)	31 (9.0)		9 (14.1)	7 (12.1)		73 (17.6)	24 (8.3)	
1	129 (29.3)	82 (23.7)		16 (25)	12 (20.7)		113 (27.2)	70 (24.3)	
2	77 (16.1)	63 (18.2)		12 (18.8)	9 (15.5)		65 (15.7)	54 (18.8)	
3	74 (15.5)	58 (16.8)		8 (12.5)	12 (20.7)		66 (15.9)	46 (16)	
4	54 (11.3)	62 (17.9)		8 (12.5)	11 (19.0)		46 (11.1)	51 (17.7)	
5	52 (10.9)	45 (13)		9 (14.1)	6 (10.3)		43 (10.4)	39 (13.5)	
6	11 (2.3)	5 (1.5)		2 (2.3)	1 (1.7)		9 (2.2)	4 (1.2)	
DTN, min (SD)				47.7 (22)	44.8 (17)	0.83			
Hemorrhage, %				72	67	0.58			

DTN: door to needle time; ER: emergency room; MRS: modified ranking scale; NIHSS: National Institute of Health Stroke Scale

Table 2: Comparison of intracerebral hemorrhage-related data between 2019 and 2020

	2019 (n=139)	2020 (n=116)	p - value
ER visiting, n	46791	39016	
Stroke/ER, %	0.3	0.3	0.995
Age, year [IQR]	68 [55-79]	64 [54.5-77]	0.44
sex (male %)	59.7	69.8	0.093
ICH Score, n (%)	#		0.021*
0	34 (26.4)	29 (25.0)	
1	44 (34.1)	28 (24.1)	
2	22 (17.1)	22 (19.0)	
3	17 (13.2)	19 (16.4)	
4	7 (5.4)	18 (15.5)	
5	5 (3.9)	0	
6	0	0	
MRS, n(%)			0.001*
0	3 (2.2)	3 (2.6)	
1	23 (16.5)	13 (11.2)	
2	13 (9.4)	3 (2.6)	
3	34 (24.5)	27 (23.3)	
4	22 (15.8)	23 (19.8)	
5	37 (26.6)	21 (18.1)	
6	7 (5.0)	26 (22.4)	

ER: emergency room; ICH: Intracerebral hemorrhage; MRS: modified ranking scale. # ICH scores were not available in 10 cases.

our hospital is the only one designated to treat stroke in the eastern region of Yunlin, the findings are representative of the situation in the study areas. The findings only reflect changes in people's medical seeking behavior due to psychological stress and do not reflect any direct influence of the pandemic because the low infection rate and absence of lockdown policy in Taiwan. Moreover, this study could not determine the social impact of the reduction in acute management for patient with minor stroke. However, the results revealed the perception of the study population to whom stroke education program should be delivered.

In conclusion, our study reveals decline in the willingness to seek emergency services under the influence of COVID-19 among patients with less severe stroke, especially those with more risk factors. This group of population should be regarded as the key target to educate the public during the pandemic.

DISCLOSURE

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Conflicts of interest: None

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Table 3: Comparison of risk factors of stroke between 2019 and 2020

	All		Thrombolysis		Non-thrombolysis		Intracerebral Hemorrhage	
	2019 (n=479)	2020 (n=346)	2019 (n=64)	2020 (n=58)	2019 (n=415)	2020 (n=288)	2019 (n=139)	2020 (n=116)
Job								
none	346	268	42	42	304	226	107	83
farm	67	33	15	5	52	28	9	16
worker	27	25	3	4	24	21	23	21
office	39	20	4	7	35	13	15	8
Smoking, %	24	18.2	17.2	25.9	25.1	16.7	11.7	21.1
			0.046*	0.24		0.008*		0.032*
Alcohol, %	11.9	7.5	10.9	10.3	12	6.9	5.2	10.9
			0.039*	0.92		0.026*		0.073
Hypertension, %	72.9	66.2	71.9	67.2	73	66	61.7	60.2
			0.039*	0.58		0.045*		0.793
Diabetes mellitus, %	30.5	30.1	23.4	31	30.1	31.6	18.8	22.7
			0.9	0.35		0.63		0.429
Old stroke, %	16.5	11.6	15.6	12.1	16.6	11.5	17.5	15.6
			0.047*	0.571		0.056		0.669
Atrial fibrillation, %	11.9	7.5	14.1	12.1	11.6	6.6	0.6	3.1
			0.039*	0.75		0.027*		0.117

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