

Impact of the COVID-19 Pandemic in the Acute Stroke Admissions and Outcomes in a Philippine Tertiary Hospital

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Keywords

Stroke · Philippines · COVID-19 · Acute stroke

Abstract

Background and Purpose: The COVID-19 pandemic has been continuing its global spread ever since its onset, and efforts to curb the infection in multiple reports have contrasting effects on stroke severity, admissions, and outcomes. In the Philippines, where the COVID-19 pandemic shows no signs of slowing down and has been in the world's longest lockdown, we investigated the effect of the pandemic in the stroke admissions and outcomes in one of the largest tertiary hospitals in the Philippines. **Methods:** This is a retrospective, comparative study of all adult stroke patients admitted between pre-COVID-19 (February 2019–January 2020) and COVID-19 periods (February 2020–January 2021). The differences of stroke types, severity, classification, and discharge outcomes between pre-COVID-19 and during COVID-19 were analyzed in the study. **Results:** There is a decrease in total number of stroke admissions from 597 in the pre-COVID-19 period to 487 during the pandemic. Stroke patients take significantly longer time to seek hospital consultation from the onset of stroke symptoms, and significantly higher proportion of patients have moderate and severe stroke. The discharge outcome showed significantly higher

proportions of dependency upon discharge (13%) and higher proportion of death in stroke patients from 7% pre-COVID-19 pandemic to 13% during the pandemic. **Conclusions:** There was reduction in total stroke admissions, mild and transient stroke during the pandemic. There were a significantly higher proportion of stroke patients having moderate and severe stroke. The discharge outcome of stroke patients is functionally poorer during the pandemic, and more stroke patients have died compared before the COVID-19 pandemic.

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Introduction

The COVID-19 pandemic is a public health emergency that continues its relentless spread globally. The increase of COVID-19 cases and growing fatalities necessitate health care service restructuring and reallocation of resources [1].

Other countries that have been affected by COVID-19 underwent substantial changes in their own acute stroke management pathway. Multidisciplinary approaches triaging an allocation of COVID-19-dedicated areas are certain changes that have been in place in other countries [2, 3]. Beds dedicated to stroke care have been transformed

Table 1. Demographic characteristics

	Pre-COVID-19 (n = 597)	COVID-19 (n = 487)	p value
Age (mean ± SD)	60.7±14.5	59.8±15.1	0.342
Sex, n (%)			
Male	338 (57)	271 (56)	0.472
Female	259 (43)	214 (44)	
Handedness, n (%)			
Right-handed	583 (98)	473 (97)	0.465
Left-handed	14 (2)	14 (3)	
Comorbidities, n (%)			
Hypertension	506 (85)	399 (82)	0.272
Diabetes mellitus	322 (54)	201 (41)	0.001*
Atrial fibrillation	66 (11)	91 (19)	0.000*
Previous stroke	103 (17)	84 (17)	0.988
Other neurologic disease	16 (3)	26 (5)	0.024*
Dyslipidemia	270 (45)	152 (31)	0.000*
Metabolic syndrome risk factors, n (%)			
Obesity	59(10)	41(8)	0.407
Raised triglycerides	264 (44)	140 (29)	0.001*
Lowered HDL	33 (6)	43 (9)	0.034*
Hypertension	503 (84)	399(82)	0.308
Impaired fasting glucose	325 (54)	198 (41)	0.001*
Onset-to-door time, h (mean ± SD)	20±27	26±48	0.015*
dMRS (mean±SD)	2.00±1.84	2.53±1.94	0.001*
Baseline NIHSS (mean ± SD)	7.46±7.67	9.28±8.44	<0.001*
Stroke type, n (%)			
Acute ischemic stroke	385 (64)	316 (65)	0.000*
Acute hemorrhagic stroke	115 (19)	129 (26)	
Transient ischemic attack	96 (16)	39 (8)	
Cerebral venous thrombosis	1 (0)	3 (1)	
Stroke severity, n (%)			
Mild	384 (64)	239 (49)	0.001*
Moderate	162 (27)	178 (37)	
Severe	51 (9)	70 (14)	
Discharge outcome, n (%)			
Alive independent	476 (80)	353 (72)	0.02*
Alive dependent	80 (13)	73 (15)	
Dead	41(17)	61(13)	
Three-month outcome, n (%)			
Alive independent	515 (86)	388 (80)	0.006*
Alive dependent	42 (7)	34 (7)	
Dead	40 (7)	65 (13)	

* Level of significance a <0.05.

into COVID-19-dedicated intensive care units to cater the influx of severe COVID-19 patients [4]. As the public shifts their attention to COVID-19, many institutions have reported a decreased number of stroke admissions and decreased emergency room consultation for stroke [1, 3, 5, 6]. Along with these are noted delayed reporting of stroke symptoms and longer last known-well time to consult time [6–10]. There are however contrasting reports from other studies such as reduction in minor

stroke and transient ischemic attack (TIA) with no substantial impact on hemorrhagic and severe stroke frequency [7, 11] and no significant change in outcomes of stroke patients during pandemic [12, 13]. In the Philippines, there has been no report on the impact of COVID-19 pandemic in terms of frequency, severity, outcomes of acute stroke care where strict stay-at-home quarantine measures have been in place since March 15, 2020 in an effort to curb the spread of COVID-19 [14].

With contrasting reports on the impact of the severity of stroke at admission and outcomes, but an observed decrease in stroke admissions and longer onset-to-admission time has been somewhat universal, we aim to report the impact of the COVID-19 pandemic in the Philippines in terms of frequency, severity, and outcomes of acute stroke.

Methods

This is a retrospective, comparative study of all adult patients (aged 19 years and above) who presented in the emergency room of The Medical City, the Philippines with stroke-like symptoms and was later diagnosed to have acute ischemic stroke, hemorrhagic stroke, cerebral venous thrombosis, or TIA between pre-COVID-19 (February 2019–January 2020) and COVID-19 period (February 2020–January 2021). Stroke mimics, traumatic brain injury, subdural hemorrhage, and patients who underwent hospital transfer or discharge against medical advice have been excluded from the study.

Using the TOAST classification, the ischemic stroke was classified as follows: large vessel atherosclerosis, small vessel occlusion, cardio-embolism, stroke of other etiology, and stroke of undetermined etiology. The acute hemorrhagic stroke subtype was classified as: intraparenchymal hemorrhage and subarachnoid hemorrhage. Stroke severity was assessed using the NIH stroke score (NIHSS), evaluated by trained neurology residents and consultants. They were trichotomized as follows: **mild**: NIHSS 0–5, **moderate**: NIHSS 6–20, and **severe**: NIHSS ≥ 21 .

Discharge outcome have been classified using the Modified Rankin Scale (MRS), and they were trichotomized as **alive and independent**: MRS 0–2, **alive and dependent**: MRS 3–5, and **dead**: MRS 6. The study protocol was approved by the Institutional Review Board of The Medical City, Philippines.

Statistical Analysis

Descriptive analysis of the demographic and clinical characteristics was done using frequency and percentage for categorical data. Mean and standard deviation were used for continuous data with normal distribution. Median and IQR were done for nonnormally distributed variables, and independent *t* test and χ^2 test were done for comparison studies. All statistical analyses were performed using SPSS version 25, and the level of significance was set at <0.05 .

Results

The demographic characteristics of stroke patients are shown in Table 1. There was no significant difference in terms of age, sex, and handedness among stroke patients during the pre-COVID-19 and COVID-19 period. The proportion of diabetic and dyslipidemic patients were significantly lower before the pandemic. Significantly higher proportions of stroke patients with atrial fibrilla-

Table 2. Acute ischemic stroke comparison

	Pre-COVID-19 (n = 385)	COVID-19 (n = 316)	p value
TOAST classification, n (%)			
Large vessel atherosclerosis	68 (18)	62 (20)	
Small vessel atherosclerosis	244 (63)	161 (51)	0.014*
Cardio-embolic	46 (12)	57 (18)	
Other etiology	12 (3)	17 (5)	
Undetermined	15 (4)	19 (6)	
Procedure, n (%)			
Thrombolysis alone	27 (7)	27 (8.5)	
Thrombectomy alone	1 (0.3)	9 (2.8)	0.018*
Both	4 (1)	1 (0.3)	
AcSU admission, n (%)	219 (56.9)	87 (27.4)	0.000*
Stroke severity, n (%)			
Mild	258 (67)	167 (53)	
Moderate	106 (28)	114 (36)	<0.001*
Severe	21 (5)	35 (11)	
Discharge outcome, n (%)			
Alive independent	316 (82)	240 (75)	
Alive dependent	51 (13)	46 (14)	0.035*
Dead	18 (5)	30 (9)	
Three-month outcome, n (%)			
Alive independent	331 (86)	269 (85)	
Alive dependent	35 (9)	16 (5)	0.006*
Dead	19 (5)	32 (10)	

* Level of significance $\alpha < 0.05$.

tion and other neurologic diseases were seen during the pandemic than the pre-pandemic period. It has been observed that stroke patients during the pandemic take significantly longer time to seek hospital consultation from onset of stroke symptoms (20 h of mean onset-to-door time before the pandemic to 26 h during the pandemic).

The baseline NIHSS is significantly higher during the pandemic, and significantly higher proportion of patients have moderate and severe stroke before the pandemic. The discharge outcome of stroke patients showed significantly lower proportions of patients with favorable functional outcome during the pandemic and significantly higher proportions of dependency upon discharge. There is also a significantly higher proportion of death in stroke patients from 7% pre-COVID-19 pandemic to 13% during the pandemic. The 3-month post discharge outcome of patient during the pandemic had significantly higher proportions of mortality than pre-COVID-19 (7% vs. 13%) and less proportion of stroke patients with functional independence during the pandemic compared to the pre-pandemic period (86% vs. 80%).

Table 3. Acute hemorrhagic stroke comparison

	Pre-COVID-19 (N = 115)	COVID-19 (N = 129)	p value
Subtype, n (%)			
Intraparenchymal hemorrhage	95 (83)	98 (76)	0.008*
Subarachnoid hemorrhage	20 (17)	31 (24)	
Stroke severity, n (%)			
Mild	36 (31)	34 (26)	0.650
Moderate	52 (45)	60 (47)	
Severe	27 (23)	35 (27)	
AcSU admission, n (%)	78 (67.8)	49 (38)	0.000*
Discharge outcome, n (%)			
Alive independent	65 (57)	72 (56)	0.668
Alive dependent	28 (24)	27 (21)	
Dead	22 (19)	30 (23)	
Three-month outcome, n (%)			
Alive independent	89 (78)	80 (62)	0.017*
Alive dependent	5 (4)	16 (12)	
Dead	21 (18)	33 (26)	

* Level of significance $\alpha < 0.05$.

An acute ischemic stroke comparison in Table 2 showed a significant difference in ischemic stroke TOAST classification between the pre-pandemic and pandemic period. During the pandemic, a significantly higher proportion of stroke patients had large vessel, cardio-embolic stroke, stroke of other etiology, and undetermined cause. On the other hand, a significant decrease in small vessel atherosclerosis was observed during the COVID-19 pandemic. The proportion of ischemic stroke patients given thrombolysis only and thrombectomy only was significantly higher during the pandemic. However, there was significantly lower proportion of ischemic stroke patients receiving both thrombolysis and thrombectomy during pandemic than before. Acute stroke unit admission was significantly reduced to almost half from 56.9% pre-pandemic to 27.4% during the pandemic. The severity of ischemic stroke was significantly affected during the pandemic period where cases of mild stroke were significantly lower, while moderate and severe stroke were significantly higher during the COVID-19 period. Outcomes on discharge were also significantly different. During COVID-19, ischemic strokes had higher mortality and had more dependent stroke patients upon discharge. Three-month post-discharge also showed significantly higher mortality but had less functional dependence during pandemic than the pre-pandemic period.

As seen in Table 3, there was a significantly higher cases of hemorrhagic strokes during the pandemic period. There was a significantly lower proportion of intraparen-

chymal hemorrhages during the COVID-19 period and significantly higher proportions of subarachnoid hemorrhages from 17% to 24% during pandemic. There was significant reduction in acute stroke unit admissions for hemorrhagic strokes during the pandemic. There was no significant effect on the severity and discharge outcomes of hemorrhagic stroke patients during the pandemic. However, 3 months post discharge, there was a significantly higher mortality, and more proportion of patients were functionally dependent during the COVID-19 period.

Table 4 shows comparison of the demographic characteristics of patients treated with either thrombolysis or thrombectomy alone or both between the pre-COVID-19 and COVID-19 periods. There were no significant differences between age, sex, mean NIHSS, stroke severity, and outcomes of treated patients between pre-pandemic and pandemic periods. However, during the pandemic, there is a significantly higher proportion of diabetic patients who underwent ischemic stroke procedures. The ictus-to-door time is significantly higher among these patients during the pandemic (3.41 h during pandemic vs. 1.67 h pre-pandemic). Among ischemic stroke patients who received acute ischemic stroke procedure, there were more patients treated with thrombectomy alone during the pandemic, while there was a significantly lower proportion of patients given thrombolysis and both thrombectomy and thrombolysis during pandemic than pre-pandemic. The proportion of acute stroke unit admissions

Table 4. Demographic characteristics of patients treated with thrombolysis and/or thrombectomy

Characteristics	Pre-COVID-19 (n = 32)	COVID-19 (n = 37)	p value
Age	64 (13.40)	65 (16.73)	0.371
Sex, n (%)			
Male	25 (78.1)	25 (67.6)	0.328
Female	7 (21.9)	12 (32.4)	
Comorbidities, n (%)			
Hypertension	5 (15.6)	9 (24.3)	0.370
Diabetes mellitus	10 (31.3)	25 (67.6)	0.003*
Renal disease	30 (93.8)	35 (94.6)	0.881
Previous stroke	27 (84.4)	32 (86.5)	0.804
Atrial fibrillation	21 (65.6)	16 (43.2)	0.063
Dyslipidemia	15 (46.9)	25 (67.6)	0.082
Ictus-to-door time, h (mean ± SD)	1.67±0.89	3.41±5.31	0.002*
NIHSS (mean ± SD)	10±6.29	11±6.81	0.424
Procedure, n (%)			
Thrombolysis alone	27 (84.4)	27 (73)	0.019*
Thrombectomy alone	1 (3.1)	9 (24.3)	
Both	4 (12.5)	1 (2.7)	
Stroke severity, n (%)			
Mild	10 (31.3)	9 (24.3)	0.633
Moderate	19 (59.4)	22 (59.5)	
Severe	3 (9.4)	6 (16.2)	
AcSU admission, n (%)	30 (93.8)	20 (54.1)	0.000*
Discharge outcome, n (%)			
Alive independent	23 (71.9)	30 (81.1)	0.651
Alive dependent	6 (18.8)	5 (13.5)	
Dead	3 (9.4)	2 (5.4)	
Three-month outcome, n (%)			
Alive independent	23 (71.9)	34 (91.9)	0.062
Alive dependent	6 (18.8)	1 (2.7)	
Dead	3 (9.4)	2 (5.4)	

* Level of significance a <0.05.

among patients treated with ischemic stroke procedures was significantly reduced to almost half during the pandemic (93.8% pre-pandemic vs. 54.1% during pandemic).

Table 5 shows the sub-analysis of all stroke patients during the pandemic period with known COVID-19 status. From the 487 stroke patients during pandemic, 183 patients were not included in this sub-analysis because they did not undergo COVID-19 testing and therefore had undetermined COVID-19 status. Among those patients who were tested for COVID-19, 31 patients tested positive while 273 patients were negative. As shown in Table 5, there were a significantly higher proportion of COVID-19-positive patients with large vessel atherosclerosis and cardio-embolic strokes, while COVID-19-negative patients have higher proportions of small vessel occlusion and undetermined etiology. COVID-19-positive stroke patients have higher proportions of severe stroke and lower proportion of mild and moderate stroke. There

are however no significant differences among COVID-19-positive stroke patients in terms of stroke type, hemorrhagic stroke subtype, and stroke severity compared to COVID-19-negative patients.

Discussion

The study showed evidence in the effect of the COVID-19 pandemic in the clinical characteristics and discharge outcomes of stroke admissions in one of the largest tertiary hospitals in the Philippines. Efforts to curb the spread of COVID-19 included strict stay-at-home measures and granulated lockdowns in the Philippines. Possibly due to the steadily increasing number of COVID-19 infections, there is an evident decrease in the total number of stroke admissions from 597 in the pre-COVID-19 period to 487 during the pandemic. The decrease in stroke

Table 5. Cerebrovascular disease and known COVID-19 status sub-analysis during COVID-19 period

	COVID-19 positive (n = 31)	COVID-19 negative (n = 273)	p value
Stroke type, n (%)			
Ischemic stroke	17 (55)	176 (64)	0.238
Hemorrhagic stroke	11 (35)	81 (30)	
Cerebral venous thrombosis	1 (3)	15 (5)	
Transient ischemic attack	2 (6)	1 (0)	
TOAST classification, n (%)			
Large-vessel atherosclerosis	5 (29)	42 (24)	0.008*
Small-vessel	3 (18)	88 (50)	
Cardio-embolic	5 (29)	29 (17)	
Undetermined	0 (0)	10 (6)	
Other etiology	4 (24)	7 (3)	
Subtype of hemorrhagic stroke, n (%)			
Intraparenchymal hemorrhage	7 (64)	61 (75)	0.540
Subarachnoid hemorrhage	4 (36)	20 (25)	
Stroke severity, n (%)			
Mild	9 (29)	111 (41)	0.111
Moderate	12 (39)	115 (42)	
Severe	10 (32)	47 (17)	
Discharge outcome, n (%)			
Alive independent	14 (45)	189 (69)	0.025*
Alive dependent	9 (29)	42 (15)	
Dead	8 (26)	42 (15)	
Three-month outcome, n (%)			
Alive independent	16 (57)	198 (77)	0.047*
Alive dependent	4 (14)	14 (5)	
Dead	8 (29)	45 (18)	

* Level of significance $\alpha < 0.05$.

admission though not shown in the table has been maximal during the implementation of the Enhanced Community Quarantine in the National Capital Region of the Philippines beginning March 15, 2020 up to May 31, 2020 [15]. Significantly longer mean onset-to-door time during the pandemic was observed which could be reflective of the difficulty in transportation, multiple interhospital transfers due to lack of vacancy, and reluctance to seek hospital consult. Similar patterns of significant delays of no less than half an hour were both observed in Southern Europe and other Asian countries, while in Hong Kong, a delay was observed but their finding was not significant [6, 16, 17]. These delays in seeking medical care are detrimental to stroke outcome and could be an important reason for significantly higher proportion of patients with moderate and severe stroke upon baseline examination during the COVID-19 pandemic.

Lower proportions of diabetic and dyslipidemic patients during the COVID-19 pandemic as seen in this study have also been observed by Teo et al. [10] and Gu et al. [16], while an increase in proportion of these risk

factors in stroke patients during the COVID-19 pandemic was reported by other studies [7, 13]. A significantly higher proportion of patients with atrial fibrillation during the pandemic (19%, p value = 0.000) was observed in this study which was similarly reported in other countries [7, 10, 13]. While these risk factors for stroke would have significant effect in stroke severity and TOAST classification of patients, it is of note that similar to other studies there is significantly lower proportion of TIA cases during the pandemic [3, 7, 9, 10, 13]. As this study was not able to evaluate patients who did not seek hospital consultation, it is possible that the lower proportion of TIAs could be due to reluctance to seek hospital consultation for minor stroke symptoms. These missed opportunities can be detrimental to stroke care and outcomes for TIA patients as this condition when not properly cared to pose a 10–20% risk for subsequent stroke to develop in a span of 90 days [18, 19]. The proportion of hemorrhagic stroke was significantly higher during the pandemic at 26% of stroke admissions compared to 19% pre-pandemic which may also be a reflection of those with worse stroke mani-

festation of being seen and admitted at hospitals during the pandemic. These findings are different from those reported by Bhatia et al. [20], where the increase in number of hemorrhagic strokes was not significant during pandemic. Taking these factors into consideration, the outcomes of stroke admissions have been greatly impacted by the COVID-19 pandemic with significantly lower proportion of stroke cases discharged with good functional outcome and higher proportion of dependent patients upon discharge during pandemic which was also observed in other countries [7, 16, 17, 21]. The proportion of stroke admissions resulting in mortality almost doubled from 7% before COVID-19 to 13% during COVID-19, and these were also seen in previous studies [20, 21]. There are many possible contributory factors resulting to more stroke cases having poor discharge outcome, and most of these factors are possibly secondary to: limited mobility in the Philippines while on the longest lockdown in the world, reluctance to seek consultation, and increasing COVID-19 cases that overwhelm the emergency room of the hospital. Though the retrospective nature of the study was not able to confirm these to individual patients, it is still highly possible. What was evident in the study was the significant reduction in the proportion of patients receiving acute stroke unit admission, therefore missing out on more appropriate acute stroke care during pandemic that reaches up to approximately half compared to pre-pandemic proportions. This reduction may be possibly due to the conversion of the acute stroke unit into COVID-isolation intensive care unit and may have disrupted the chain of stroke care during pandemic which had greatly affected stroke outcomes including higher mortality seen in other studies [7, 16, 17, 20, 21].

A sub-analysis of ischemic stroke cases in Table 2 showed a significantly higher proportion of large vessel atherosclerosis and cardio-embolic strokes during COVID-19. A significantly lower proportion of mild ischemic stroke cases and significantly higher moderate and severe ischemic stroke cases seen during the pandemic may also be reflective of the delayed onset-to-consult time. The proportion of thrombolysis and endovascular treatment was significantly affected with even higher number of endovascular treatments done during the pandemic reflective of the higher proportion of cases of large vessel atherosclerosis. A higher rate of thrombolysis during pandemic among ischemic stroke patients was similarly observed by Bhatia et al. [20] in India while other studies in Asian and European countries reported opposite results [3, 6, 12, 16, 17]. Despite this, the discharge

outcome of ischemic stroke patients is still poor during the pandemic with more ischemic stroke patients dying than pre-pandemic. It is still possible that in-hospital delays and factors contribute to poorer functional outcome despite these emergency stroke treatments such as delays possibly due to disinfections of equipment and rooms in between cases and donning and doffing of personal protective equipment. It is not objectively measured in this study but it can still be contributory. In the sub-analysis of hemorrhagic stroke, there is a significantly higher proportion of subarachnoid hemorrhages during the pandemic, but stroke severity and discharge outcomes of these cases are not significantly different compared to before COVID-19. Since the stroke severity of hemorrhagic cases did not differ significantly, the outcomes were not affected in contrast to ischemic stroke cases who had higher severity therefore had worse outcomes. It is definitely possible that delaying hospital admission or consultation for ischemic stroke patients are more detrimental because of the possibility of an initially mild presentation being ignored until progression of symptoms ensued.

Among patients who received acute ischemic stroke interventions (thrombolysis or thrombectomy alone or both) in Table 4, there was a significantly longer ictus-to-door time during the pandemic similarly observed in other countries [6, 10, 16, 17]. This might be the reason why during the pandemic, patients given acute ischemic stroke procedures had higher proportion of thrombectomy done than thrombolysis. The shorter window period for eligibility to receive thrombolysis was significantly affected during this period which may also be due to factors such as reluctance to seek immediate consult unless stroke symptoms were severe warranting thrombectomy along with limitation in mobility prolonging onset to hospital consult time due to the implemented lockdown.

The COVID-19 status of stroke patients are also sub-analyzed and shown on Table 5. There is a significantly higher proportion of large vessel atherosclerosis and cardio-embolic stroke in COVID-19-positive patients. Higher proportion of death and dependence among COVID-19 stroke patients are seen while there is better discharge functional outcome among COVID-19-negative patients. A variety of possible mechanisms of stroke in SARS-COV-2 has been proposed such as an exaggerated systemic inflammation in cases of severe infection, hypercoagulability due to elevated d-dimer levels, cardiac involvement from virus-related cardiac injury resulting to cardio-embolism, and direct invasion resulting in hemorrhagic encephalopathy [22, 23]. Among those with mild COVID-19 infection, all stroke patients were discharged

with good functional outcome, while higher functional dependence and mortality were seen as COVID-19 infection worsen. Though direct causative and pathophysiological link between SARS-COV-2 and development of stroke has not yet been established, it is known that an activated inflammatory cascade in acute infections, hypercoagulability, and hemorrhagic encephalopathy could have an effect on the development and outcome of stroke [22, 23]. Clearly, an additional insult from COVID-19 hampers neuroprotection and has significant effect on the functional outcome and survivability of stroke patients.

Conclusion

In the Philippines, the country with the longest lockdown in the world, there were significantly higher proportions of stroke patients with atrial fibrillation and other neurologic diseases during the pandemic. Stroke patients take significantly longer time to seek hospital consultation from onset of symptoms with 26 h mean onset-to-door time during the pandemic. There is significantly higher proportion of patients having moderate and severe stroke. Admission to acute stroke units was significantly reduced to almost half of the pre-pandemic proportions during COVID-19 pandemic. Among patients given acute ischemic stroke intervention, there is significantly lower proportion of patients given thrombolysis while more patients were treated with thrombectomy during the pandemic. The discharge outcome of stroke patients showed significantly lower proportions of patients with favorable functional outcome during the pandemic than before COVID-19 and significantly higher proportions of dependency upon discharge. There is also a significantly higher proportion of death in stroke patients during the pandemic.

In COVID-19-positive stroke patients, there is higher proportion of large vessel atherosclerosis and cardio-embolic stroke. There is a higher proportion of death and dependence among COVID-19-positive stroke patients.

Limitations

Due to the retrospective nature of the study, certain inferences are not objectively measured and assessed including in-hospital complications, post discharge recurrences, and complications; therefore, other possible contributing factors may have also influenced the changes in stroke outcome after some time.

Statement of Ethics

The study has been reviewed and approved by a local ethics review board: The Medical City Institutional Review Board (TMC-IRB) on December 2020 at the IRB office, Medical Library, Podium Building, the Medical City. The study has also been approved to no longer require informed consent of the participants due to the retrospective nature of the study by TMC-IRB.

Conflict of Interest Statement

The authors declare that there is no conflict of interest.

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Author Contributions

Study conception and study design: L.E.P. Quiles and P.A.B. Diamante. Data acquisition: L.E.P. Quiles and P.A.B. Diamante. Data analysis and interpretation: L.E.P. Quiles, P.A.B. Diamante, and J.L.V. Pascual. Manuscript writing and editing: L.E.P. Quiles, P.A.B. Diamante, and J.L.V. Pascual. Critical revision: L.E.P. Quiles, P.A.B. Diamante, and J.L.V. Pascual. Supervision: J.L.V. Pascual.

Data Availability Statement

Anonymized data not published in this article will be made available by request from any qualified investigator.

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