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A Chilean Experience of Telestroke in a COVID-19 Pandemic Year

Carlos Delfino[a] Enrico Mazzon[a, b, c] Gabriel Cavada[d, e]
Paula Muñoz Venturelli[a, c, f] Alejandro M. Brunser[b, c, g] Felipe Jurado Díaz[b, h]
Lorena Lara Cisternas[b] Diego Rocha Jiménez[b] Mirya Arévalo Valdivia[b]
Diego Rojas Torres[b] Eloy Mansilla[a, b, c, h]

[a]Centro de Estudios Clínicos, Instituto de Ciencias e Innovación en Medicina (ICIM), Facultad de Medicina, Clínica Alemana Universidad del Desarrollo, Santiago, Chile; [b]Unidad de TeleACV, Servicio de Salud Metropolitano Sur, Santiago, Chile; [c]Department of Neurology and Psychiatry, Clínica Alemana de Santiago, Facultad de Medicina Clínica Alemana, Universidad del Desarrollo, Santiago, Chile; [d]Research and Clinical Trials Unit, Department of Academic Development and Research, Clínica Alemana de Santiago, Santiago, Chile; [e]School of Public Health, Facultad de Medicina, Universidad de Chile, Santiago, Chile; [f]The George Institute for Global Health, Faculty of Medicine, University of New South Wales, Sydney, NSW, Australia; [g]Department of General Emergency, Clínica Alemana de Santiago, Facultad de Medicina Clínica Alemana, Universidad del Desarrollo, Santiago, Chile; [h]Department of Neurology and Neurosurgery, Facultad de Medicina, Universidad de Chile, Santiago, Chile

Keywords
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Abstract
Background and Purpose: Telemedicine for stroke patients' care (telestroke [TS]) has grown notably in recent decades and may offer advantages during health crisis. Hospital admissions related to stroke have decreased globally during the COVID-19 pandemic, but scarce information is available regarding the effect of COVID-19 in TS. Using a population-based TS registry, we investigated the impact of the first year of the COVID-19 pandemic throughout our TS network in Santiago, Chile. ***Methods:*** Stroke codes evaluated after the onset of COVID-19 restrictions in Chile (defined as March 15, 2020) were compared with those evaluated in 2019. We analyzed differences between number of stroke codes, thrombolysis rate, stroke severity, and time from the stroke onset to hospital admission. ***Results:*** We observed that the number of stroke codes and the number of patients undergoing reperfusion therapy did not change significantly ($p = 0.669$ and 0.415, respectively). No differences were found with respect to the median time from the stroke onset to admission ($p = 0.581$) or in National Institutes of Health Stroke Scale (NIHSS) scores ($p = 0.055$). The decision-making-to-needle time was significantly shorter in the COVID-19 period (median 5 min [IQR 3–8], $p < 0.016$), but no significant changes were found at the other times. ***Conclusions:*** This study demonstrates the potential of adapting TS to extreme situations such as the COVID-19 pandemic, as well as the importance of establishing networks that facilitate patient access to quality treatments.

Karger@karger.com
www.karger.com/ced

Correspondence to:
Eloy Mansilla, eloymansilla@uchile.cl

Karger

Introduction

The application of telemedicine to the care of patients with acute stroke (telestroke [TS]), has grown remarkably in the past decades. TS enables such patients to be remotely evaluated, thereby enabling optimal treatment and management even in clinically underserved areas, thus removing geographical disparities in access to expert care [1]. TS systems allow the administration of thrombolytic treatment in community and rural hospitals and facilitate the adequate transfer of patients to more complex urban hospitals with a stroke center [1, 2].

Since the start of the pandemic, SARS-COV2 (COVID-19) disrupted the healthcare systems of many nations [3]. Chile was severely affected by the pandemic with a cumulative incidence rate of 10,004.5 per 100,000 inhabitants [4]. Due to the rapid increase in the number of COVID-19 patients, hospital care capacity was exceeded. This situation forced the redistribution of human and material resources and the establishment of hospitalization rooms exclusively dedicated to this viral infection, reducing the number of hospital beds for other medical and surgical services. Despite national and international recommendations that faced stroke patients during the pandemic [5, 6], numerous studies reported decreased visits from stroke patients [7–9]. In Latin America, a 15.9% decrease in stroke hospitalizations was reported [10]. Likewise, in Chile during 2020 the hospitalizations for stroke decreased by 37.6% according to national public records [11].

With the relatively new technology being offered through current TS, few reports describe the effects of a pandemic year on TS treatment [12]. A report from US TS network has informed the maintenance of acute stroke treatment during the first period of the COVID-19 pandemic [13]. In the present investigation, we sought to evaluate the impact of the first year of the COVID-19 pandemic on the local TS network in Santiago, Chile, focusing on the number of consultations and severity of the National Institutes of Health Stroke Scale (NIHSS), using the same period of 2019 for comparison.

Materials and Methods

Brief Description of the Stroke Pathway in the TS Network

The Santiago TS Unit was formed in 2017 [14] and is made up of seven hospitals around Chile connected to a virtual hub. When a patient arrives at the hospital with symptoms suggesting a stroke within 4 h of last known well, blood tests are taken, and a nonenhanced brain CT scan is done. If no bleeding is detected, a "stroke code" is activated, and the TS unit is notified by telephone, where a neurologist is on duty for TS consultations. Subsequently, the consultation is initiated by videoconference through a mobile telemedicine device. Through a videoconference consultation the neurologist can view and ask to the patient, direct the examination performed by the emergency physician, and access the radiology repository to view the CT scan. If thrombolysis is indicated, the neurologist participates remotely in the management of the patient together with the emergency team. If a patient arrives outside the window period or bleeding is detected on the brain CT scan, the TS code is not activated, and local protocols are performed instead.

Procedures

Based on collected data, we performed a retrospective study of acute stroke pathway parameters in our TS unit and included all ischemic stroke codes. We excluded for this analysis hemorrhagic strokes. This information was collected anonymously and had the approval of the Scientific Ethics Committee of the South Metropolitan Health Service.

We compared equivalent coverage periods between March 2019 and March 2021. March 15 was chosen as the cutoff date for the statistical analysis because it was the starting date for social restrictions, corresponding to the most significant changes in the daily activities of residents in the country. The restrictions included the suspension of educational activities, public gatherings, cultural activities, some public services, public transportation, and industrial activities, among other measures. Some organizations suggested slight changes to protocols to streamline the care of stroke patients [8] although no additional facilities were opened for diverted patients with suspected stroke.

This study aimed to investigate the impact of the COVID-19 pandemic in stroke care in the TS network. We tested the null hypothesis that (i) the number of stroke code did not change during the COVID-19 pandemic, (ii) the number of patients who received thrombolytic care was not modified, and (iii) there were no changes in the time between stroke onset and hospital admission as quality outcome of the TS process.

The primary outcomes were the number of stroke codes, the number of patients who underwent thrombolysis treatment, and the door-to-needle time as a predictor of quality outcome of the TS process, respectively [15]. Also, we investigated whether there was a change in mean age, sex, time between stroke onset and hospital admission, and the severity of new acute ischemic stroke diagnoses according to the NIHSS [16].

Statistical Analysis

The number of stroke codes was presented as total number of cases by period and was expressed as cumulative incidence. We compared stroke codes from March 15, 2019, to March 14, 2020 (pre-COVID-19), with the same period from March 15, 2020, to March 14, 2021 (COVID-19 time). COVID-19 hospitalizations were expressed as cumulative incidence. Descriptive statistics are presented as counts and percentages for categorical variables. Means and standard deviations, median, and interquartile range are reported for continuous variables. The characteristics of the pre-COVID-19 and COVID-19 group consultations were compared by univariate analysis using the Student t test or Mann-Whitney U test, according to normality in continuous variables. For categorical variables comparisons were done using the χ^2 or Fisher's exact test. Differences with $p < 0.05$ were considered statistically significant. Statistical analysis was performed using Stata IC16.

Table 1. Demographic characteristics

	Pre-COVID-19	COVID-19 period	*p* value
Demographic characteristics			
Stroke code activations, *n*	532	546	0.669
Thrombolysis	157 (29.5)	171 (31.3)	0.415
Female	280 (53)	326 (49)	0.094
Age	67 (55–77)	67 (55–77)	0.406
Medical history			
Hypertension	368 (69.1)	461 (68.9)	0.950
Diabetes	172 (32)	209 (31)	0.708
Previous stroke	119 (22.4)	127 (18.9)	0.151
Active smoking	73 (13.7)	101 (15)	0.510
Atrial fibrillation	52 (9.8)	52 (7.8)	0.256
Previous myocardial infarction	34 (6.4)	46 (6.7)	0.816
Dyslipidemia	34 (6.4)	29 (4.3)	0.119
Stroke characteristics			
Time in minutes to presentation since last known well	107 (50–180)	104 (55–170)	0.581
Proportion of participants with known time of the stroke onset, %	95	97	0.346
Stroke severity by the NIHSS	5 (2–11)	6 (2–13)	0.055
Hospital response characteristics, min			
Door-to-needle time	55 (44–67)	58 (47–73)	0.070
Door-to-CT time	12 (5–24)	14 (6–27)	0.114
Door-to-VC time	36 (25–50)	36 (27–52)	0.560
Decision-making-to-needle time	6 (4–10)	5 (3–8)	0.016

Data presented as *n* (%) or median (IQR).

Results

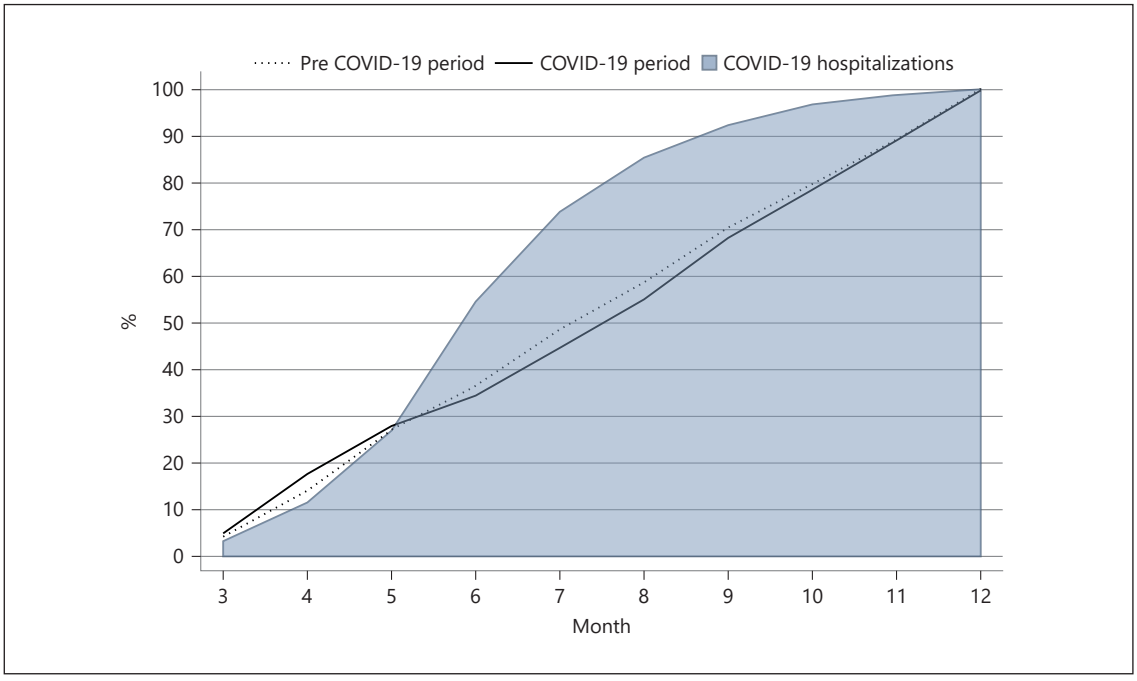
Between March 15, 2019, and March 15, 2021, 1,078 stroke codes were registered, of which 546 were admitted in the COVID-19 period. No data were excluded. No difference was found in terms of age of presentation, sex, or known medical history between groups (shown in Table 1).

The number of stroke code consultations did not differ between the two groups ($p = 0.669$). Despite the fact that each hospital was affected in a different way, the total number of consultations did not vary when comparing both periods except for one smaller hospital (F) (shown in online suppl. Table 1; for all online suppl. material, see www.karger.com/doi/10.1159/000523920). When comparing the cumulative incidence of consultations in both periods, no difference was found between the groups (shown in Fig. 1). Also, hospitalizations for COVID-19 during 2020 had no effect on the cumulative incidence of stroke codes. Of the total alerts, 171 patients were thrombolyzed in the COVID-19 group, but there was no statistical difference from the pre-COVID-19 group ($p = 0.415$) (shown in Table 1).

No significant changes were found in time of presentation to emergency department since last known well, stroke severity measured by NIHSS scale, or stroke care quality outcomes, except for the decision-making-to-needle time, which was significantly shorter in the COVID-19 period (median 5 [IQR 3–8] vs. 6 [IQR 4–10], $p < 0.016$) (shown in Table 1; online suppl. Fig. 1). In-hospital activated stroke codes were excluded for this analysis.

Discussion

This study provides evidence of the potential for adapting TS to extreme public health situations such as the COVID-19 pandemic. Although some patients may experience a delay in seeking medical care due to local characteristics [15], our data demonstrated that the decision to seek medical help was independent of these factors. This finding indicates that both patients and prehospital medical staff correctly recognized the need for urgent evaluation and treatment of stroke despite the threat of COVID-19 infection. Regarding in-hospital times, we did



Color version available online

Fig. 1. Cumulative incidence of stroke codes before COVID-19 and during COVID-19 pandemic, and COVID-19 hospitalizations. *x*-axis represents calendar months, starting in March. The pre-COVID-19 period was defined from March 15, 2019, to March 14, 2020, and COVID-19 from March 15, 2020, to March 14, 2021.

not find differences between the pre-COVID-19 and COVID-19 periods. We also noted that the prior training of personnel and the maintenance of close communication ties to face the pandemic was essential.

While neurologists around the world have reported a decline in the number of admitted stroke cases during the COVID-19 pandemic era, mainly due to cases with a transient, mild, or moderate presentation of stroke [3, 10], the role of TS is still unclear. A study published in the US based on 171 hospitals in a large TS network reported maintenance of acute stroke treatment with TS, despite a 27% decrease in consultation volume [13]. Our findings are consistent with this report and demonstrate the possibility of maintaining quality of care in smaller TS centers in Latin America, despite the reduction by 37.6% of stroke hospitalizations during 2020 [11]. This could be explained by the fact that patients who present to the emergency room for stroke symptoms are those who meet criteria for receiving treatment. Interestingly, a decrease in the decision-to-needle time during the COVID-19 period was detected. The improvement in the stroke care process may be related to local urgency quickly transferring patients to the ward in a pandemic health situation with overcrowded emergency rooms (or green corridors), the protected stroke code as well as, a greater experience of the local TS team. Although there are multiple factors that can influence the treatment of stroke during catastrophes and public health crises, it is important to encourage the use of TS as a strategy to guarantee good and efficient treatment of relevant and urgent medical conditions such as stroke.

Strengths and Weaknesses

The study uses a prospective collected database to analyze the impact of 1 year of the pandemic and the role of TS services to patients and the healthcare system. To our knowledge, this is the first Latin American study to publish data on stroke care via TS after a year of the spread of COVID-19.

This study may be limited because we used the year 2019 as a comparator and not the average of queries from previous years. However, we believe that this method also has value because doing so enabled us to compare similar periods and avoid temporal trends for stroke. Additionally, each health center had its own COVID-19 testing protocol, and the incidence of COVID-19 infection among all stroke patients without respiratory symptoms was not investigated. Furthermore, data on COVID-19 hospitalizations were obtained from public records and must be carefully analyzed. However, we decided to in-

corporate this information in Figure 1 since it provides valuable context on the situation. Finally, although our results may not be generalizable to other regions with different protocols for stroke care and different social and healthcare responses to the COVID-19 pandemic, this study does provide data related to the use of TS services in such situations.

Conclusions

This study demonstrates the potential and importance of TS networks to face the current COVID-19 pandemic. Expanding the use of TS networks will enable neurologists to provide care to patients quickly and effectively in the face of public health catastrophes.

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Statement of Ethics

The present study conforms to the guidelines issued in the Declaration of Helsinki. In this retrospective study, we used anonymized clinical data, with no direct patient contact. The Ethics Committee of the South Metropolitan Health Service (Santiago, Chile) determined that this study does not constitute clinical research and is thus exempt from ethics committee review and informed consent, approval number 124-18112020.

Conflict of Interest Statement

Carlos Delfino, Gabriel Cavada, Felipe Jurado Díaz, Lorena Lara Cisternas, Diego Rocha Jiménez, Mirya Arévalo Valdivia, Diego Rojas Torres, and Eloy Mansilla report no conflicts of interest. Enrico Mazzon reports receiving a research grant from Boehringer-Ingelheim for the RUTA registry. Paula Muñoz Venturelli and Alejandro Brunser report receiving research grants support from ANID Fondecyt Regular outside of this work.

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Author Contributions

Carlos Delfino, Enrico Mazzon, and Paula Muñoz Venturelli designed the study. Enrico Mazzon, Felipe Jurado, Lorena Lara, Diego Rocha Jiménez, Mirya Arévalo, Diego Rojas Torres, and Eloy Mansilla provided the data. Gabriel Cavada and Carlos Delfino analyzed the data. Carlos Delfino, Enrico Mazzon, Paula Muñoz Venturelli, Alejandro Brunser, and Eloy Mansilla, wrote the manuscript. All the authors reviewed and critically revised this work.

Data Availability Statement

The data that support the findings of this study are available upon request from the corresponding author.

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