

IMPACT OF THE COVID-19 PANDEMIC ON THE MORTALITY RATE AND CLINICAL OUTCOME OF PATIENTS ADMITTED TO PAULS STRADIŅŠ CLINICAL UNIVERSITY HOSPITAL WITH SPONTANEOUS INTRACEREBRAL HAEMORRHAGE

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Spontaneous intracerebral haemorrhage (SICH) remains the most devastating type of stroke with the highest morbidity and mortality. Since the start of the COVID-19 pandemic, serious modifications have been made in health care systems, affecting patients with all kinds of disease, including SICH. This study compared mortality rates, and clinical and functional outcomes of patients diagnosed with SICH in the pre-COVID-19 and COVID-19 time periods. Retrospective analysis was performed using patient data from Pauls Stradiņš Clinical University Hospital from 2018 to 2021, dividing it into two subgroups based on the beginning of the COVID-19 pandemic. In this study, 329 patients in total were analysed. No statistically significant differences were found in mortality rate ($p = 0.389$) and neurological status at hospital admission ($p = 0.309$) between the time periods prior to COVID-19 and during the COVID-19 period. A statistically significant difference was found in the clinical status of patients ($p = 0.016$) measured using the Glasgow Coma Scale, indicating a worse level of consciousness of patients diagnosed with SICH at the time of admission to the hospital in the COVID-19 period. No statistically significant differences were found in the clinical outcome ($p = 0.204$) and functional outcome ($p = 0.556$) of the patients at discharge from the hospital. In the COVID-19 period, admission of patients with SICH fell by 25%. For patients with SICH, the COVID-19 pandemic was associated with a reduced admission rate and a worse level of consciousness at the time of admission, calling for further research to identify what caused it and how to avoid delayed medical help in the case of the development of acute neurological symptoms during the COVID-19 outbreak.

Keywords: National Institute of Health Stroke Scale (NIHSS), coronavirus-disease 19 (COVID-19), Modified Rankin Scale (mRS), haemorrhagic stroke, arterial hypertension.

INTRODUCTION

Spontaneous intracerebral haemorrhage (SICH) accounts for up to 24% of haemorrhagic strokes and approximately 10–20% of all strokes worldwide (Garg *et al.*, 2019; Han *et al.*, 2021). Since the mortality rate of SICH can be as high as 40% (Al-Khaled *et al.*, 2020), it is associated with a higher morbidity and mortality rate compared to ischaemic stroke (Garg *et al.*, 2019; Markus, 2021). In the case of

SICH, it is very important to initiate immediate intensive care to prevent rapid neurological deterioration and death (Abdulazim *et al.*, 2020). According to the World Health Organisation, the Coronavirus 2019 (COVID-19) pandemic started on 11 March 2020 (Han *et al.*, 2021). As a response, governments and health care institutions introduced wide-ranging security measures and restrictions in order to limit the further outbreak of the COVID-19 disease. These restrictions raised concerns about their possible impact on the

availability of timely medical care for acute illnesses such as SICH. Although there is increasing evidence that COVID-19 infection can cause SICH (Aghagoli *et al.*, 2021; Lawton *et al.*, 2021; Beyrouiti *et al.*, 2021; Simonetto *et al.*, 2022), limited availability of medical care resources during the pandemic is another important risk factor that could have affected patients with SICH. According to the latest research, admission rates for patients with SICH during the COVID-19 pandemic in some medical centres decreased significantly (Abdulazim *et al.*, 2020), while in others there was no difference when comparing pre-COVID-19 and COVID-19 pandemic time periods (Diegoli *et al.*, 2020). Furthermore, there is increasing evidence of poorer clinical outcome in patients with acute ischaemic stroke during the COVID-19 pandemic (Liu *et al.*, 2020), while data on patients with SICH are limited.

The aim of our study was to compare mortality rates and clinical and functional outcomes in patients with SICH in the pre-COVID-19 pandemic and at the COVID-19 pandemic in Pauls Stradiņš Clinical University Hospital.

MATERIALS AND METHODS

A single-centre retrospective study was conducted, which included all patients with a diagnosis of SICH admitted to Pauls Stradiņš Clinical University Hospital during the time period from January 2018 to December 2021. The severity of stroke in hospitalised and discharged patients was assessed using the validated Latvian version of the National Institute of Health Stroke Scale (NIHSS) (Jurjans *et al.*, 2017). The level of consciousness of the patients at the time of hospital admission was estimated using the Glasgow Coma Scale (GCS). The Modified Rankin Scale (mRS) was used to assess the functional outcome of the stroke at the time of discharge. The functional outcome was defined as “Good” if the mRS rating was 0–2, “Moderate” if the mRS rating was 3 and “Poor” if the mRS rating was 4 and 5. Data analysis was performed using IBM SPSS Statistics software version 27.0. The results were statistically analysed using descriptive statistics method and the Mann–Whitney U test. A p -value < 0.05 was considered statistically significant.

RESULTS

A total of 329 SICH patients were admitted to Pauls Stradiņš Clinical University Hospital during the study period. For data analysis, the patients were divided into two subgroups: a pre-COVID-19 pandemic subgroup (consisting of 199 patients treated during the time period from January 2018 to March 2020) and the COVID-19 pandemic subgroup (consisting of 130 patients treated from March 2020 to December 2021). The mean age of patients with SICH in the pre-COVID-19 group was 69.12 (20–94) years, while in the COVID-19 group it was 66.66 (22–98) years. There was no statistically significant difference in age between these two groups ($p = 0.083$). 47.11% (155) of the patients were

male and 52.89% (174) were female. The most common cause of SICH was arterial hypertension (58.3%) (Table 1).

The in-hospital mortality rate was slightly higher in the COVID-19 subgroup (45.7%) than in the pre-COVID-19 subgroup (40.9%), although the difference was not statistically significant ($p = 0.389$). The Glasgow Coma Scale (GCS) rating at admission was available for 257 patients. The median GCS score was significantly worse in the COVID-19 group (11.68 points) than in the pre-COVID-19 group (9.98; $p = 0.016$). NIHSS evaluation was available for 247 patients at admission and for 157 patients at discharge. The mean NIHSS score at admission in the pre-COVID-19 and COVID-19 group was similar — 11.96 points and 11.31 points, respectively ($p = 0.309$). Both groups showed improvement at hospital discharge without significant differences: the mean NIHSS score in the pre-COVID-19 subgroup was 5.49 points and 4.85 points in the COVID-19 subgroup ($p = 0.204$). The functional outcome at discharge by mRS was analysed in 243 patients, with no statistically significant differences between the study groups ($p = 0.556$) (Table 2).

In the pre-COVID-19 period, on average 7.85 patients per month with SICH were admitted to Pauls Stradiņš Clinical University Hospital while in the COVID-19 period only 5.86 patients per month on average were admitted. Data showed that in the period of the COVID-19 pandemic there was a 25% reduction in patients with SICH admission at Pauls Stradiņš Clinical University Hospital compared to the period before the pandemic.

Table 1. Aetiology of spontaneous intracerebral haemorrhage (SICH) in the period 2018–2021

Aetiology of SICH	n (%)	Pre-COVID-19 group	COVID-19 group
Arterial hypertension	192 (58.3%)	112 (56.3%)	80 (61.5%)
Unknown	82 (24.9%)	56 (28.1%)	26 (20.0%)
Arterial aneurysm rupture	10 (3%)	3 (1.5%)	7 (5.4%)
Postoperative	5 (1.5%)	2 (1.0%)	3 (2.4%)
Cavernous angioma	3 (0.9%)	1 (0.5%)	2 (1.5%)
Arteriovenous malformation	9 (2.7%)	8 (4.0%)	1 (0.8%)
Amyloid angiopathy	4 (1.2%)	2 (1.0%)	2 (1.5%)
Coagulation disorders	20 (6.0%)	13 (6.5%)	7 (5.4%)
Brain tumour	3 (0.9%)	2 (1.0%)	1 (0.8%)
Venous cerebral infarction	1 (0.3%)	0 (0.0%)	1 (0.8%)

Table 2. Functional outcome at discharge from the hospital using the Modified Rankin Scale (mRS) in patients with spontaneous intracerebral haemorrhage (SICH) in pre-pandemic and pandemic periods

mRS	Pre-COVID-19 group	COVID-19 group	p
0–2	19 (12.8%)	14 (14.7%)	0.556
3	16 (10.8%)	9 (9.5%)	0.556
4–5	54 (36.5%)	28 (29.5%)	0.556

We also compared the proportion of surgically treated patients: 11.1% (n = 22) in the pre-COVID-19 group and 18.9% (n = 24) in the COVID-19 group, without statistically significant difference ($p = 0.337$).

DISCUSSION

Spontaneous intracerebral haemorrhage remains one of the most dangerous medical emergencies, with a high risk of rapid early neurologic deterioration and death. Despite continuing studies and the search for new treatment options and improvements in medical care, the morbidity and mortality rate after SICH remains very high (Hostettler *et al.*, 2019). At the beginning of the COVID-19 pandemic in March 2020, numerous medical experts and practitioners were concerned about the impact this difficult situation will have on serious medical conditions, including emergency situations such as SICH. However, our data did not support our fear that limited medical care resources during the pandemic could have worsened the outcome of the SICH. We did not find statistically significant differences between the mortality rate and functional and clinical outcomes of SICH patients in the time periods before COVID-19 and COVID-19. However, since the investigation was retrospective, only intrahospital mortality data was available for the analysis of the data and there is still the possibility that mortality 30 days after suffering SICH could still be higher during the time of the pandemic. More research is needed not only to analyse possible hospital-dependent factors that affect the outcome of SICH patients, and also to evaluate different outpatient factors, such as high-quality outpatient care, the availability of rehabilitation and other factors that could undoubtedly affect patients after suffering from SICH. During the pandemic, the number of patients with SICH admitted to the hospital decreased by approximately 25%, which can be explained by fear of patients becoming infected with COVID-19 in the hospital, thus worsening their clinical situation even more. This fear could lead to delays in seeking help in emergency situations. Although the neurological status rated by NIHSS at admission to the hospital did not show any difference in the periods prior to and during the COVID-19 pandemic, patients hospitalised in the COVID-19 period were significantly more severe by GCS. This might indicate that patients with milder symptoms avoided hospitalisation, or it might have been related to delayed hospitalisation. The difference between the NIHSS and GCS assessments could also be explained by lack of availability of the NIHSS assessment for some patients.

At the beginning of the investigation, we hypothesised that the frequency of surgical therapy decreased during the time of the COVID-19 pandemic in the population of patients with SICH. We considered the possibility that due to the many new regulations and efforts to limit the spread of the COVID-19 virus, doctors could have preferred conservative treatment options in the easiest cases. However, this hypothesis was not supported by the data in our investigation. This could be explained by the fact that neurosurgical op-

eration in the case of SICH is a life-saving treatment that could not be delayed despite other external factors.

There have been many studies worldwide reporting that COVID-19 infection can lead to spontaneous intracerebral haemorrhage (Pavlov *et al.*, 2020; Aghagoli *et al.*, 2021; Beyrouiti *et al.*, 2021; Shinohara *et al.*, 2021). However, only a few articles have discussed how the pandemic could have affected patients with SICH (Abdulazim *et al.*, 2020; Liu *et al.*, 2020; Han *et al.*, 2021). Our data suggest that SICH patients may have delayed seeking medical help at the time of the COVID-19 pandemic. As a result, we suggest that additional public health measures may be needed to inform patients about the importance of turning to help in a timely manner, as immediate medical attention is critical to increasing the probability of a good outcome of both ischaemic stroke and spontaneous intracerebral haemorrhage (Pavlov *et al.*, 2020).

CONCLUSIONS

Spontaneous intracerebral haemorrhage remains a highly serious medical emergency with severe long-term sequelae. According to the data in our investigation, the mortality rate of SICH did not increase significantly during the COVID-19 pandemic and the clinical and functional outcomes did not deteriorate. Admission to the hospital of SICH patients decreased during the pandemic; while the clinical condition of the patients evaluated by GCS at the time of admission was poorer. More research is needed to identify possible causes of the decrease in the number of patients with SICH admitted to the hospital, as well as of the worsening state of the patients at the time of admission.

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COVID-19 PANDĒMIJAS IETEKME UZ MIRSTĪBU UN KLĪNISKO IZNĀKUMU PACIENTIEM AR SPONTĀNU INTRACEREBRĀLU HEMATOMU PAULA STRADIŅA KLĪNISKAJĀ UNIVERSITĀTES SLIMNĪCĀ

Spontāna intracerebrāla hematoma (SICH) ik gadu izraisa 20% no visiem cerebrāliem infarktiem. Mirstība un izteikta funkcionāla nespēja pēc SICH saglabājas augstā līmenī. Ar COVID-19 pandēmiju ieviestās izmaiņas veselības aprūpes sistēmā ietekmējušas ne tikai pacientus ar COVID-19 infekciju, bet arī pacientus ar citām saslimšanām. Tika veikts retrospektīvs pētījums, analizējot pacientu datus Paula Stradiņa Klīniskās universitātes slimnīcā (PSKUS) laika periodā no 2018. līdz 2021. gadam. Pētījumā tika analizēti 329 pacientu dati (199 pacienti pirms COVID-19 pandēmijas sākuma un 130 pacienti COVID-19 pandēmijas laikā). Salīdzinot mirstības rādītājus ($p = 0,389$) un neiroloģisko stāvokli iestāšanās brīdī slimnīcā ($p = 0,309$), netika atrasta statistiski nozīmīga atšķirība starp abiem laika periodiem. Salīdzinot pacientu klīnisko stāvokli pēc Glāzgova komas skalas iestāšanās brīdī slimnīcā, tika konstatēta statistiski nozīmīga atšķirība ($p = 0,016$) starp šiem laika periodiem, norādot uz sliktāku pacientu apziņas līmeni iestāšanās brīdī slimnīcā COVID-19 pandēmijas laikā. Pandēmijas laikā PSKUS par 25% samazinājās uzņemto pacientu ar SICH skaits. Statistiski ticama atšķirība, salīdzinot pacientu klīnisko ($p = 0,204$) un funkcionālo ($p = 0,556$) stāvokli izrakstīšanas brīdī no slimnīcas, netika konstatēta. COVID-19 pandēmija ir saistīta ar samazinātu pacientu ar SICH uzņemšanu slimnīcā, kā arī sliktāku apziņas līmeni iestāšanās brīdī slimnīcā, tādēļ nepieciešami tālāki pētījumi, lai identificētu cēloņus un novērstu novēlotu vēršanos pēc medicīniskās palīdzības akūtu neiroloģisku simptomu attīstības gadījumā.