Trends of ischemic stroke admission during two years of COVID-19 pandemic: A retrospective cross-sectional study at a tertiary hospital in Indonesia

Pipit Mei Sari¹,², Atika Mira Agniana¹,², Mohammad Saiful Ardhi¹,²

ABSTRACT

Introduction: There is no much information on how admission rates of non-coronavirus disease 2019 (COVID-19) diseases altered after two years of COVID-19 pandemic. The aim of this study was to determine the pattern of ischemic stroke admission rates within the two years of the COVID-19 pandemic in Indonesia.

Method: A cross-sectional retrospective study investigated the admissions data of ischemic stroke was conducted at a tertiary hospital in Indonesia between January 2019 and December 2021. Ischemic stroke patients aged over 18 years old were identified using the ICD-10 I63 code. The data was accumulated every month and analyzed descriptively. We also analyzed the admissions data of ischemic stroke patients with COVID-19 and in-hospital mortality was calculated.

Results: There were 2,710 ischemic stroke patients treated between 2019 and 2021 of which the number decreased from 1,535 patients in 2019 to 730 in 2020 and only 445 cases in 2021. During 2019-2021, a total of 777 patients (28.67%) died during hospitalization; the most was in 2021 (33.3%). There is a consistent downward trend in ischemic stroke admissions during the COVID-19 pandemic with the monthly average admissions decreased 52.4% in 2020 compared to 2019 and 38.9% in 2021. Despite that, the mortality rate of ischemic stroke patients in the hospital increased from 26.5% in 2019 to 30.4% in 2020, and 33.3% in 2021. The number of ischemic stroke patients coinfected with COVID-19 was 3.5% (26/730) in 2020 and 8.1% (36/445) in 2021. Of all 62 ischemic stroke cases with COVID-19 in 2020-2021, 36 died yielded 58.1% in-hospital mortality rate.

Conclusion: The decreased admissions and the increased mortality rate of ischemic stroke patients in particular those coinfected with COVID-19 during the first two years of pandemic should draw government attention to the necessity of improving stroke managements in Indonesia.

Keywords: Admission rate, COVID-19, in-hospital mortality, ischemic stroke, stroke.

INTRODUCTION

Many nations have reported a decrease of admissions rate of stroke patients since coronavirus disease 2019 (COVID-19) was declared as a global pandemic in March 2020.¹ Due to the rapid infection rate, the Indonesian government has implemented various policies to reduce the number of COVID-19. Physical and social distancing, restrictions on community activities, and even lockdown have also been implemented. The hospitals have also begun to implement a policy of limiting elective surgical procedures due to restructuring to improve health services related to COVID-19 and the reduction in the number of medical personnel due to being infected with COVID-19.² The number of diseases that need rapid treatment such as myocardial infarction and ischemic stroke also decreased.³⁻⁶ In the early years of pandemic, the number of intervention treatments for cerebrovascular diseases was also reported to have decreased mainly to avoid the spread of COVID-19.²⁻⁹

The public’s reluctance to visit the hospitals and leave their houses during the pandemic was also a barrier for ischemic stroke patients receiving appropriate treatment as soon as possible.⁷ Since COVID-19 is known to cause cytokine storm and hyperinflammation, it impairs the endothelical cells of blood vessels leading to thrombosis, subsequently has a potential to cause ischemic stroke.¹⁻³ Studies also reported the occurrences of cryptogenic strokes in young patients infected with COVID-19.¹⁻³ Notably, the effect of the pandemic on stroke incidence and the disruptions of its management could be more significant than the COVID-19 patients itself. Therefore, we aimed to determine the trend of ischemic stroke patient admissions during the first two years of pandemic in Indonesia.
METHODS
This study was an observational cross-sectional retrospective to investigate of the admission of ischemic stroke patients in Dr Soetomo General Hospital Surabaya, Indonesia. Dr Soetomo General Hospital is a tertiary referral hospital for stroke in eastern Indonesia. During the COVID-19 pandemic, the hospital was also the main referral hospital for COVID-19 patients in East Java. The data were retrieved from the hospital database. Diagnosis of ischemic stroke was identified using ICD-10 I63 code (cerebral infarction) for the first, second, third, fourth, or fifth diagnosis of the discharge code. In addition, COVID-19 was identified using ICD-10 B34.2 code (coronavirus infection, unspecified site) as instructed by the Indonesia Ministry of Health.

All ischemic stroke patients included in this study met the inclusion criteria: (a) registered in medical record of Department of Neurology between January 2019 (pre-pandemic) to December 2021; (b) the patients aged over 18 years old; (c) already had laboratory tests and head computed tomography scan (CT-scan) to confirm the ischemic stroke; and (d) have been confirmed beforehand whether the status of COVID-19 infection. The exclusion criteria were: (a) the motoric impairments caused by other than ischemic stroke (e.g., infection, tumor, or trauma); and (b) patients who refused the COVID-19 test. The patients’ data were collected along with the total amount of in-hospital mortality cases each month.

The main outcome of this study was the total number of admissions of all patients with ischemic stroke within 2019-2021 period. The secondary outcome was the admissions of ischemic stroke patients with COVID-19 and the in-hospital mortality rate every month in 2020 and 2021. Fluctuations in the percentage of admissions and in-hospital mortality each month and year were analyzed descriptively.

RESULTS

Admission rate of ischemic stroke patients
During 2019-2021, there were 2710 ischemic stroke patients treated at Dr Soetomo General Hospital with the highest total admissions (1535) in 2019 (pre-pandemic) and the lowest number (445) in 2021. The monthly admission rate of ischemic stroke patients between 2019-2021 are presented in Figure 1.

In the pre-pandemic era (2019) the average admission of ischemic stroke patients was 127.9 cases per month. This case numbers decreased during the pandemic: 60.8 cases monthly in 2020, and 37.1 cases each month in 2021. Data on the number of admissions each month of ischemic stroke are presented in Table 1. The reduction rate in total admissions was significant: 52.4% between 2019 and 2020; and 38.9% between 2020 and 2021. These coincided with a rise of confirmed COVID-19 patients in Indonesia.

Mortality rate of ischemic stroke patients
Of all 2710 ischemic stroke patients during 2019-2021, 777 patients died during treatment. Monthly number of in-hospital mortality cases were 62 patients in 2020 and 36 in 2021 (i.e., 38% increase between 2020 and 2021). Of all 62 ischemic stroke cases with COVID-19 in 2020-2021, 58.1% (36/62) died during treatment. Monthly number of admission and in-hospital mortality of ischemic stroke patients with COVID-19 are presented in Table 2.

DISCUSSION
Our data suggested that there was a reduction in the rate of admissions of ischemic stroke patients by 52.4% during COVID-19 pandemic compared to the era before the pandemic (2019). The decline was in occurred mostly between March and April 2020, from a total of 122 admissions in March 2020 to 59 cases only in April 2020, before the pandemic (2019). The decline was in occurred mostly between March and April 2020, from a total of 122 admissions in March 2020 to 59 cases only in April 2020. A study in Germany which included stroke centers also reported a reduction of up to 46% in stroke admission. In Bangladesh the overall reduction was

Figure 1. The admission rate of ischemic stroke patients every month during the period 2019-2021.
Table 1. Monthly admission rate and in-hospital mortality rate of ischemic stroke patients before and during COVID-19 pandemic.

<table>
<thead>
<tr>
<th>Month</th>
<th>2019 (pre-pandemic)</th>
<th>2020</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Case</td>
<td>Mortality rate</td>
<td>Case</td>
</tr>
<tr>
<td>Jan</td>
<td>135</td>
<td>23.0</td>
<td>148</td>
</tr>
<tr>
<td>Feb</td>
<td>124</td>
<td>27.4</td>
<td>136</td>
</tr>
<tr>
<td>March</td>
<td>106</td>
<td>26.4</td>
<td>122</td>
</tr>
<tr>
<td>Apr</td>
<td>117</td>
<td>23.1</td>
<td>59</td>
</tr>
<tr>
<td>May</td>
<td>99</td>
<td>31.3</td>
<td>50</td>
</tr>
<tr>
<td>Jun</td>
<td>104</td>
<td>26.9</td>
<td>21</td>
</tr>
<tr>
<td>Jul</td>
<td>141</td>
<td>22.7</td>
<td>16</td>
</tr>
<tr>
<td>Aug</td>
<td>144</td>
<td>25.0</td>
<td>33</td>
</tr>
<tr>
<td>Sept</td>
<td>139</td>
<td>24.5</td>
<td>26</td>
</tr>
<tr>
<td>Oct</td>
<td>140</td>
<td>29.3</td>
<td>34</td>
</tr>
<tr>
<td>Nov</td>
<td>160</td>
<td>30.6</td>
<td>44</td>
</tr>
<tr>
<td>Dec</td>
<td>126</td>
<td>28.6</td>
<td>41</td>
</tr>
<tr>
<td>Total</td>
<td>1535</td>
<td>26.5</td>
<td>730</td>
</tr>
</tbody>
</table>

Figure 2. Percentage of in-hospital mortality of ischemic stroke patients per year (2019-2021).

In addition, our study found that the reduction continued until 2021 with 39% reduction. This finding is almost similar to other non-COVID cases, acute coronary syndrome. The surveys from World Stroke Organization in many countries like the UK, Iran, and Chile also showed a sharp reduction in the number of stroke admission. The exact causes of this decline is still unclear. There are, however, several possible explanations. Many people are hesitant to seek immediate medical help or delay hospital visits for fear of being infected with COVID-19 in treatment facilities even if they have minor symptoms of ischemic stroke or a transient ischemic attack (TIA). The isolation policy for patients who are confirmed COVID-19 such as if the patient dies in the isolation room, the body cannot be treated according to the wishes of the family can be the reason as well.

Comparing the pandemic period of March-December 2020 with March-December 2021, there was still a decline in the admission rate, from an average of 44.6 cases/month to 38.8 cases/month (-13%). This finding was different from what we expected. In the second year of the COVID-19 pandemic, it was expected that the health system be more settled and the rate of COVID-19 could be controlled, therefore non-COVID cases could receive optimal treatment. However, our data revealed the contrary condition of which the admission rate of ischemic stroke patients continued to decline. This may be due to the public's fear of COVID-19 infection continued till 2021. One of the leading causes is the vaccination coverage was still low in the community although vaccination efforts have been implemented by the Indonesian government since January 2021. The emergence of information about the existence of new variants of SARS-CoV-2 such as the Delta variant in January 2021 and vaccine hesitancy might also impact on the public's reluctance and fear to visit hospitals. As a consequence, this might have led to an increase the number of ischemic stroke patients admitted with more severe conditions and potentially increased the rate of in-hospital mortality, which is consistent with our findings.
The secondary endpoint of this study was in-hospital mortality of ischemic stroke patients. Stroke is the world’s second greatest cause of mortality, and is a major contributor to the cause of death in developing countries like Indonesia. In-hospital mortality rates for patients with acute ischemic stroke are still hovering at 3% to 22%. In the recent study, our data indicated that the mortality of ischemic stroke patients was 26.5% in 2019. This rate is higher compared to previous findings. Despite the absence of high-quality statistics in developing nations, more than two-thirds of stroke-related deaths occur in these countries. During the first year of the pandemic (2020), the mortality rate of ischemic stroke patients was 30.4%. The percentages of in-hospital mortality kept increasing despite the decreasing number of hospital admission. This may be because, during the pandemic, most people with mild stroke symptoms did not seek medication at the hospital and only those severe condition admitted into the hospital. This condition was also reported in the United States, Croatia, Denmark, Philippines, and other countries. Other factors related to in-hospital mortality such as the history of prior stroke, risk factors, and complications (respiratory and cardiovascular complications or infection) should be assessed too because it can cause the risk of in-hospital mortality increased.

Another secondary endpoint of this study was the trends in the admission rate of ischemic stroke patients with COVID-19 infection during the two years of the pandemic. As we expected before, despite the decreasing rate of overall ischemic stroke admission, the rate of ischemic stroke with COVID-19 remained unchanged and the mortality rate was 57.7% and 58.3% in 2020 and 2021, respectively. This is in line with the results of a study in 2021 which stated that COVID-19 was associated with a higher mortality rate in people who had ischemic stroke. Another study also found that ischemic stroke patients with COVID-19 had a worse outcome and associated with persistent long COVID-19 symptoms. A meta-analysis found that many risk factors (hypertension, hyperlipidemia and diabetes) were high in patients with ischemic stroke and COVID-19. Unfortunately, in our study, data of these risk factors were unable to be assessed. The risk of death may be increased as a result of delayed or even skipped hospitalization due to SARS-CoV-2 infection.

There are some limitations of this study. This was a single-center retrospective observational study on hospital admission records in one tertiary hospital in Indonesia. We were not able to analyze the severity of stroke at admission, complications or other risk factors that could directly affect the rate of in-hospital mortality. Therefore, further studies analyzing the data from other hospitals in Indonesia together with risk factors are recommended.

**CONCLUSION**

During 2020, the ischemic stroke admissions decreased by more than 50% than in the previous year. Although the efforts to control COVID-19 has been implemented more robust in 2021, the decline of the admission rate continuing until 2021. In contrast, in-hospital mortality rate of ischemic stroke patients increased overtime between 2020 and 2021; the mortality rate of ischemic stroke patients with COVID-19 was more than 50% in both 2020 and 2022. Our findings highlight that optimizing ischemic stroke management during the pandemic needs to be improved to reduce mortality.

**ETHICS APPROVAL**

The study protocol of this study was reviewed and approved by the Health Research Ethics Committee of Dr Soetomo General Hospital (0924/LOE/301.4.2/V1/2022).

---

**Table 2. Monthly admission number and in-hospital mortality rate of ischemic stroke patients with COVID-19 during two years of the pandemic.**

<table>
<thead>
<tr>
<th>Month</th>
<th>2020</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number case</td>
<td>Number of deaths</td>
</tr>
<tr>
<td>Jan</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Feb</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>March</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Apr</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>May</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Jun</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Jul</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Aug</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Sept</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Oct</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Nov</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Dec</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>15</td>
</tr>
</tbody>
</table>
ACKNOWLEDGMENTS

None.

DISCLOSURE OF CONFLICTS OF INTEREST

The authors declare no conflict of interest regarding the manuscript.

FUNDING

This case study received no external funding.

AUTHOR CONTRIBUTION

AMA and PMS contributed to the concept and design of the study, collecting the data, writing the article. MSA involved in supervising the study and reviewing the final article for significant intellectual content.

REFERENCES


