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Maintained acute stroke admission during the first wave COVID-19 pandemic in Sweden, a register-based study

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Objectives: Clinicians and researchers have addressed concerns about the negative impact of COVID-19 outbreaks on the ability of health care systems to provide timely assessment and acute therapies to patients with stroke. The aim of this study is to describe stroke care during the first wave of the COVID-19 pandemic compared to the same period the year before at an acute care hospital in Sweden. **Materials and Methods:** In this cohort study data were collected from March 1st to August 31st in 2019 and 2020 on all patients diagnosed with stroke and TIA and registered at Danderyd Hospital in the national quality registry (Riksstroke). Data were completed with information from the hospital record. Sweden had no lockdown during 2020. **Results:** During the study period in year 2019 there were 426 registered stroke patients at Danderyd hospital, compared to 403 registered stroke

patients the same period during 2020 ($p = 0.483$). The number of minor stroke and TIA during the period in 2019 compared to 2020 were 468 versus 453 respectively (minor stroke $p = 0.475$ versus TIA $p = 0.50$). **Conclusions:** There were no difference in the number of patients diagnosed with stroke and TIA during the first wave of the COVID-19 pandemic.

Keywords: Stroke—COVID-19—Lock-down—Non-compulsory restrictions

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Objectives

Clinicians and researchers have addressed concerns about the negative impact of COVID-19 outbreaks on the ability of health care systems to provide timely assessment and acute therapies to patients with stroke¹. Also, the COVID-19 infection has been suggested to increase the stroke incidence, though usually occurring in the presence of other cardiovascular risk factors^{2, 3}, and to increase mortality rate among stroke patients^{4,5}.

In Sweden, there was no lockdown during 2020, but there were public recommendations and restrictions. In contrast to most countries, preschools and grade schools remained open. The Swedish main objective with the actions coupled to the COVID-19 pandemic was similar to that of most other countries; to reduce the spread of the infection. However, instead of a full lock down, the strategy in 2020 was to keep parts of the society open. The majority of actions to reduce the spread rely upon voluntary compliance with the Public Health Authority's evolving set of recommendations⁶. These recommendations were non-compulsory but individuals were expected to follow them, despite the lack of fines for any failure. The inhabitants were urged to work from home if possible and to avoid travels, and also to avoid unnecessary health care visits. Further, limited social contacts were encouraged, specifically among individuals with the greatest risk for COVID-19 complications.

The health authorities' efforts to mitigate the burden of COVID-19 pandemic on the healthcare system may have discouraged people from seeking acute treatment for stroke resulting in an increased morbidity and mortality. Several studies have shown a marked and unexplained reduction in the number of hospital admissions of patients with cardiovascular diseases such as myocardial

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infarction and stroke^{1,4,7–12} while the rate of stroke thrombectomy has been maintained^{4,10}. There have been reports of a small but significant delay to intravenous thrombolysis^{9,12} while other authors have reported maintained reperfusion interventions^{4,10,13}. Little is reported about minor stroke and TIA, but there are a few reports of a decrease in hospital admissions of patients with mild symptoms and elderly patients^{4,10}. The importance for patients with minor stroke and TIA to seek urgent hospital care is to do diagnostic work-up and implement evidence-based secondary prevention, in order to avoid future stroke events.

This study aimed to compare the presentation of stroke patients at the emergency department and medical stroke care for patients at a primary stroke centre before (year 2019) and during the first wave (year 2020) of the COVID-19 pandemic in Sweden.

Material and methods

This is a single-centre, register-based study conducted at Danderyd Hospital, an acute care hospital in Stockholm in Sweden. Danderyd Hospital has a primary stroke centre, and with a catchment population of approximately 650,000 inhabitants¹⁴.

Patients diagnosed as Stroke and TIA were prospectively registered in the Swedish national registry Riksstroke at Danderyd Hospital during the study period 1st of March to 31st of August in 2019 and the same period in 2020. Riksstroke is a validated national register with an estimated coverage of 96% of all strokes in Sweden¹⁵.

Data on baseline demographic, risk factors of stroke, time for onset of stroke symptoms, time to arrival at hospital, door-to-needle time to intravenous thrombolysis (IVT), and stroke severity at admission as measured by National Institute of Health Stroke Scale (NIHSS) are registered in Riksstroke. In addition to the data from the Riksstroke register in-hospital mortality rate, positive test for COVID-19 infection, along with planned diagnostic stroke work-up, and out-clinic follow-ups was retrieved from the hospital records and hospital registrar (Qlik-view) at Danderyd Hospital. Patients within the catchment area eligible for thrombectomy are triaged from the ambulance directly to the angio site at Karolinska hospital followed by secondary transport to the stroke unit at Danderyd hospital; these patients (18 in 2019 and 68 in 2020) are not included in the present analysis.

New hygiene guidelines were implemented when the first wave of COVID-19 pandemic hit Sweden. All hospital staff wore personal protective equipment (PPE) with direct contact with confirmed or suspected COVID-19 infected patients. PPE included face shields, face masks and sleeveless plastic aprons. Emergency care was divided into two sections, one for patients with confirmed or suspected COVID-19 infection and one section for the other patients. The X-ray department was reduced to only

one CT lab for all patients with confirmed or suspected COVID-19 infection. All stroke-patients who were candidates for IVT were treated as suspected COVID-19 patients to the contrary were confirmed by testing.

Descriptive analyses were made on baseline characteristics and the number of observations, presented as number and percentages. Differences between the 2019 and the 2020 cohort were analysed by independent t-test and by Chi2-test for categorical variables. The significance level for all the statistical tests was set to 5% and presented with 95% confidence interval (CI). Statistical analyses were performed using IBM SPSS Statistics for Windows version 27.

This investigation was approved by the Stockholm Regional Ethics Committee (2020-05226). All patients at Danderyd hospital have consented being registered in the Riksstroke-register.

This manuscript conforms to the STROBE guidelines.

Results

In total, there were 1428 patients with a COVID-19 diagnosis treated at Danderyd Hospital in year 2020 (Fig. 1). During March 1st to August 31st in 2019 there were 426 stroke patients and 209 TIA patients registered at Danderyd hospital, compared to 403 stroke patients and 206 TIA patients registered the same time period during 2020 (Tables 1 and 2). The number of minor stroke defined as NIHSS ≤ 3 , and TIA during the time period in 2019 compared to 2020 were 468 versus 453 respectively (Table 1 and 2), (minor stroke $p = 0.475$ versus TIA $p = 0.50$).

The mean age of stroke patients was 76 years of age in 2019 compared to 74 years of age 2020 ($p = 0.18$) (Table 1). There was a significant increased delay from onset to arrival at the ED, 178 stroke patients arriving within 6 h of stroke onset in 2019 compared to 137 stroke patients in 2020 ($p < 0.001$), while patients who sought medical care within 6–24 h increased from 124 to 173 stroke patients from 2019 to 2020 ($p < 0.001$) (Table 1). The number of performed intravenous thrombolysis (IVT) on stroke patients was 52 during 2019 compared to 44 in 2020 ($p = 0.55$) (Table 1). The admission rate to stroke unit was 79% for stroke and 56% for TIA in 2019, compared to 84% for stroke ($p = 0.07$) and 88% for TIA ($p < 0.001$) in 2020 (Table 1 and 2). The door-to-needle time to IVT was 48 min in 2019 compared to 56 min in 2020 ($p < 0.05$) (Table 1). Nine stroke patients and two TIA patients were tested positive with COVID-19 at admission. Among the nine patients with stroke and COVID-19, two deceased during hospital stay (Tables 1 and 2). In-hospital mortality rate among stroke patients in 2019 was approximately 8% compared to 6% in 2020 ($p = 0.24$) (Table 1).

There was a significant decrease in the number of follow up at hospital outpatient stroke clinic of stroke and TIA patients; for stroke patients 306 in 2019 compared to

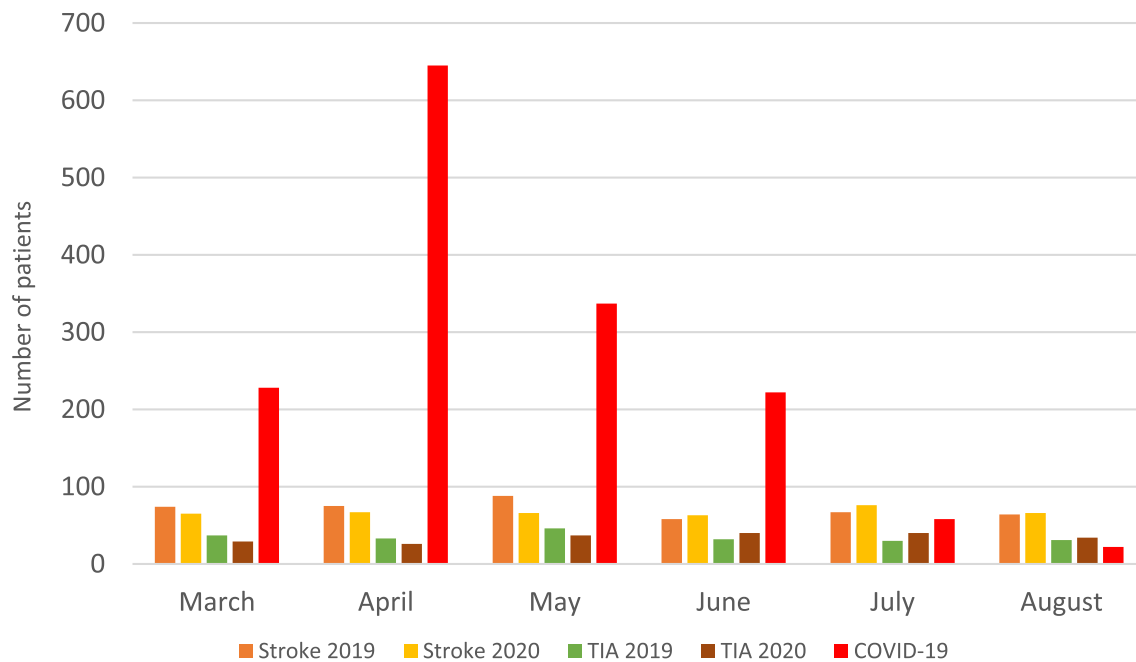


Fig. 1. Number of patients diagnosed with stroke, TIA and COVID-19 in 2020 and admitted to Danderyd Hospital during the study period in 2019 compared to 2020.

270 in 2020 ($p < 0.001$), and for TIA patients 198 in 2019 compared to 163 in 2020 ($p < 0.001$) (Tables 1 and 2). Data from the Riksstroke registry at 3 months follow-up revealed that the rate of ADL-dependency, as measured by modified Rankin Scale (mRS) 3-5 in stroke patients treated at Danderyd hospital, was 10 % for both 2019 and 2020 (these figures are from the whole year)²⁶.

Discussion

During the first wave of the COVID-19 pandemic, our study shows that patients with stroke and TIA specific symptoms did not seem to avoid presentation at the emergency department which is in contrast to reports from other authors^{10, 11}. However, there was a pre-hospital

Table 1. Baseline characteristics, follow up and deaths within hospital care for stroke patients during 1st of March to 31st of August 2019 and the same period 2020. Minor stroke was defined as NIHSS ≤ 3 at hospital admission. IVT=intravenous thrombolysis. *The percentages were calculated for the whole year, 2019 respectively 2020.

	Stroke 2019n=426	Stroke 2020n=403	p-value
Age, years, median, (IQR)	76.1 (68-84)	74.9 (71-85)	0.18
Gender, female, n, (%)	201 (47)	186 (46)	0.77
Minor stroke, n, (%)	259 (61)	247 (61)	0.48
<i>Diagnosis</i>			
Ischemic stroke, n	384	366	0.35
Hemorrhagic, n	42	35	0.43
<i>Medical history</i>			
Hypertension, n	240	245	0.19
Diabetes, n	92	118	0.01
Current smoker, n	55	60	0.43
Atrial Fibrillation, n	126	103	0.20
Previous stroke & TIA	123	100	0.19
Stroke unit care, n, (%)	336 (79)	339 (84)	0.07
Delay onset-arrival <6 h, n, (%)	178 (41)	137 (34)	<0.001
Door-to-needle time for IVT treated patients, minutes	48	56	<0.001
NIHSS, median	2	2	n.s.
Thrombolysis, n	52	44	0.55
Patients with COVID-19, n, (%)		9 (2.2)	
Death within hospital stay, n	34	25	0.24
mRS 3-5 (%) *	10	10	n.s.

Table 2. Baseline characteristics and follow up for TIA patients 1st March to 31st of August 2019 and the same period 2020.

	TIA 2019	TIA 2020	p-value
Number of patients	209	206	0.50
Age, years, mean	73.2	74.9	0.134
Gender, female, n, (%)	105 (50)	116 (56)	0.215
Delay, onset-to-arrival < 6 h, n	118	108	0.665
Patients with COVID-19, n (%)		2(1)	
Stroke unit care, n	118	141	0.012
Follow-up outpatient clinic, n	198	163	<0.001

increased delay in seeking acute health care in patients with stroke symptoms, perhaps due to some hesitation according to the health authorities' recommendations and restrictions. Also, new in-hospital hygiene routines were implemented due to the pandemic. There was a significant delay in door-to-needle time to IVT, which could be explained by our internal pandemic containment protocol¹⁶, as well as a decrease in outpatient stroke follow-up at the hospital mainly perhaps due to that patients wanted to avoid unnecessary health care visits. Other countries with lockdown have observed a transient decrease in stroke admission during lockdown^{1,9,17–20}.

The first wave COVID-19 outbreak led to a reorganization of the health care systems in Sweden as well as worldwide and extraordinary strategies were swiftly implemented to meet the increasing needs for COVID-19 patient such as resource and workforce allocation, and optimizing bed availability²¹. As a consequence, several researchers reported that stroke care suffered from a shortage of services and delays in time-dependent treatments and diagnostic work-up since the onset of the pandemic^{1,9,22–24}. The results of our study show that the in-hospital stroke care services with regards to admission to a stroke unit, the rate of performed IVT treatment was maintained at the hospital during the first wave COVID-19 pandemic, which may have been a result of the acute stroke care was separated from the acute COVID-care. Similar findings have been reported by other authors^{4, 25}. Another contributing possible explanation could also have been that Sweden did not implement a national lockdown. However, in our investigation, there was a significant decrease in stroke follow-ups at the hospital's outpatient clinic, which may have long term severe impact on the number of recurrent stroke and TIA. At Danderyd hospital, stroke and TIA patients are normally followed up at the out-patients clinic 2–3 months after discharge to finalise the diagnostic work-up, follow-up on life style risk factors and also compliance to implemented secondary prevention. There was no difference in proportion of ADL-dependent patients as measured by mRS 3–5 between year 2019 and 2020²⁶.

There was no difference in the number of patients diagnosed with minor stroke or TIA treated at the hospital. This is in contrast to other studies where authors reported a decrease in minor stroke and TIA during the pandemic year of 2020, mainly minor stroke in elderly patients^{4,10}.

There was no significant difference in in-hospital mortality rate in stroke patients between 2019 and 2020. Nine stroke patients in this study tested positive with COVID-19, and out of the nine COVID-19 patients with stroke, two deceased. Since the number of COVID-19 patients with stroke was small, no conclusions could be drawn from such limited sample. In addition, only patients presenting with COVID-19 symptoms (defined as cough, fever, dyspnea, rhinitis, sore throat, headache, nausea or myalgia) were tested with RT-PCR during the study period, but patients without these symptoms were not tested. Taken together, this makes any further conclusion difficult since the number of stroke patients with COVID-19 might be underestimated.

The strengths of this study are the large sample size and validated material retrieved from a national quality stroke register in Sweden, along with data from hospital records. There are limitations with a single-centre study considering generalizability since it only reflects the trend in one determined catchment area and may not represent all healthcare practices in Sweden or elsewhere. Although, comparing our data with national demographics, baseline and clinical characteristics of stroke patients reported from Riksstroke, the cohorts are comparable and representative of stroke patients in Sweden. Of the total number of stroke patients registered in Riksstroke in Sweden 2020, there was a decrease of 5% compared to 2019, but the coverage was 2% less in 2020 compared to 2019. The incidence of overall stroke in Sweden has also decreased over the past 10 years, from 30.000 patients suffering a stroke in 2010 compared to 25.000 patients in 2020²⁶.

Conclusions

There was no difference in the number of patients diagnosed with stroke and TIA, including minor stroke during the first wave of the Covid-19 pandemic in a primary Swedish stroke unit. This maintained admission pattern may have been related to the lack of lock-down in the society but general non-compulsory recommendations. There was an increased delay in onset-to-arrival and door-to-needle time, but the quality of in-hospital stroke medical care was mainly maintained. There was a significant decrease in stroke outpatient follow up which may have a long-term effect on recurrent stroke events. This

will, nonetheless, require longer observation and further investigation.

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Declaration of Competing Interests

None.

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