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Impact of COVID-19 on Stroke Caseload in a Major Hyperacute Stroke Unit

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Northwick Park Hospital in London, United Kingdom (UK) is one of the busiest stroke units in the country and is located in one of the areas most heavily affected by the COVID-19 pandemic in the first half of 2020. Admissions to the stroke unit and changes during the peak of COVID-19 were reviewed. Compared with the previous year, mean 96 patients were admitted with suspected stroke during April and May 2020 compared with mean 116 per month in non-COVID periods, ratio 0.82, $P = 0.01$. This reduction involved both strokes and mimics and was unlikely to have occurred by chance. Numbers of patients thrombolysed and of patients referred for thrombectomy decreased dramatically during this time. Mechanisms by which the COVID-19 pandemic and the March lockdown may have affected admissions to the unit are discussed. Reduced admissions to the stroke unit allowed it to contribute its resources to the care of patients with COVID-19 during the peak of admissions.

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Introduction

COVID-19 has presented a major challenge to health-care systems worldwide. In the UK, this has led to the National Health Service (NHS) focusing on the provision of front-line acute care and critical care capacity.¹

The Northwick Park HyperAcute Stroke Unit (HASU) is one of the busiest in the UK, admitting approximately 1,400 acute strokes per annum.² The catchment area of the Unit is generally stable with no marked seasonal variation. The Unit is the nearest stroke unit to London's major airport but this rarely results in more than two admissions of air travellers per month.

Northwick Park Hospital was affected early and severely by the COVID-19 pandemic, treating approximately 1500 confirmed COVID-19 cases between February and May

2020.³ Throughout this, the HASU maintained its service including acute admissions, thrombolysis, assessment and referral for thrombectomy, and transient ischaemic attack (TIA) assessments. Some practice modifications were made to reduce COVID-19 transmission risk, include telephone consultations for TIA, a new thrombolysis route for non-respiratory cases, altered referral pathways and telephone follow up. As part of the Hospital's response to the crisis, 16 of the 34 stroke unit beds were repurposed as a COVID-19 ward. The incidence of stroke and myocardial infarction has been reported to have reduced during the lock down measures instigated by the UK government,⁴ which has allowed some reprieve to the NHS. Similar experiences have been described internationally.⁵ We have studied this phenomenon.

Methods

Weekly stroke admission numbers for the first six months of 2020 were reviewed and compared with corresponding weeks in 2019. Admissions were recorded as stroke, TIA or stroke mimic. We used the definitions of the Sentinel Stroke National Audit Programme (SSNAP), a comprehensive real-time audit of stroke admission data with diagnoses based on full physician-based assessment including imaging results rather than discharge coding.

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Throughout the time period studied, the Hospital's stroke service remained fully operational. Sufficient beds were available for the HASU admissions and normal medical and nursing staffing levels were maintained. All eligible patients received thrombolysis and were referred for thrombectomy.

Statistical methods

Monthly admissions in the COVID-19 period, defined as April and May 2020, was compared with the non-COVID-19 period, being the remainder of the first half of 2020 and the first half of 2019. The number of admissions was assumed to follow the Poisson distribution, a commonly assumed data distribution for measurements which count the number of occurrences of an outcome.

To take into account the assumed distribution of the measurements, the analysis was performed using Poisson regression. Two different analyses were performed. The first analysis was simple (unadjusted) comparison of the number of admissions between the two time groups. A second analysis additionally adjusted for the month of measurement (as defined by months from Jan 19), which would account for any underlying trends in terms of number of admissions.

Results

The numbers and final diagnosis of patients admitted to the HASU are shown in the [Table 1](#). The unadjusted analysis showed mean $116 \pm$ standard deviation (SD) 4 admissions during non-COVID-19 periods falling to $96 \pm$ SD 4 during the COVID-19 period, a ratio of 0.82 (95% CI 0.71, 0.95) $P=0.01$. After adjustment for the underlying time trend the ratio was 0.83 (95% CI 0.71, 0.98) $P=0.03$. These indicate that the lower number of admissions during the COVID-19 period was unlikely to have occurred by chance.

Mean weekly admissions for March and April 2020 were 15% lower than in March and April 2019. All diagnoses

showed decreased numbers which continued through May 2020. Interestingly, there was an increase in admissions between 20th April and 3rd May, but admissions subsequently dropped again. The numbers during that two-week period did not exceed normal levels of activity. The cause for this increase is not clear as there were no clear antecedents identifiable in the preceding three weeks, such as changes to social isolation guidelines.

Neither of our two nearest hospitals, which do not usually admit acute stroke, reported any significant increase in stroke admissions during the study period.

Stroke mimics showed the greatest proportional reduction. Usually about a quarter of HASU admissions are coded as mimics. For the four weeks starting from 23rd March 2020 when the UK lockdown began, 14% of HASU admissions were mimics. From April through June 2020 there continued to be fewer mimics than usual.

We found no differences in median age (75 years), initial National Institute of Health Stroke Scale score (median 5, IQR 3-13) or any other measures of stroke severity between 2019 and 2020. The same proportion of patients (82%) arrived by ambulance.²

There was a significant increase in the time between symptom onset and hospital arrival (median 245 mins, IQR 101 – 647 mins, 2020, v 161 mins, IQR 94 – 446 mins, 2019) and time between arrival and first CT scan (median 37 mins, 2020 v 25 mins, 2019).

Thrombolysis numbers also fell. For most of the weeks between mid-February and mid-April 2020 fewer patients were thrombolysed than in equivalent weeks in 2019. Only one patient was thrombolysed during the week beginning 6th April. Lower than usual numbers were thrombolysed in March, April and May 2020. A transient increase in thrombolysis numbers occurred in the last week of April but following this, numbers were again low (2 per week) during the middle of May. However, the proportion of patients thrombolysed remained the same at 16%. Door-to-needle time rose from median 26 to 36 minutes.

Table 1. HyperAcute Stroke Unit activity by stroke, mimic or TIA, acute treatment and COVID-19 positivity by month, for 2019 and 2020.

Month	Total admissions	Stroke (n)	Mimic (n)	TIA (n)	Mimic %	Thrombolysed (n)	Thrombolysed %	Thrombectomy (n)	COV+
Jan 2019	159	123	30	6	19	25	20		
Feb 2019	134	96	32	6	24	20	21		
Mar 2019	166	111	43	12	26	19	17		
Apr 2019	163	111	42	10	26	17	15		
May 2019	200	133	54	13	27	22	17		
Jun 2019	167	122	33	12	18	19	16		
Jan 2020	189	126	53	10	28	29	23	8	0
Feb 2020	156	105	40	11	26	20	19	4	0
Mar 2020	143	100	39	4	27	14	14	1	18
Apr 2020	135	103	26	6	19	16	16	1	18
May 2020	137	104	26	7	19	16	15	3	4
Jun 2020	149	124	22	3	15	17	14	7	0

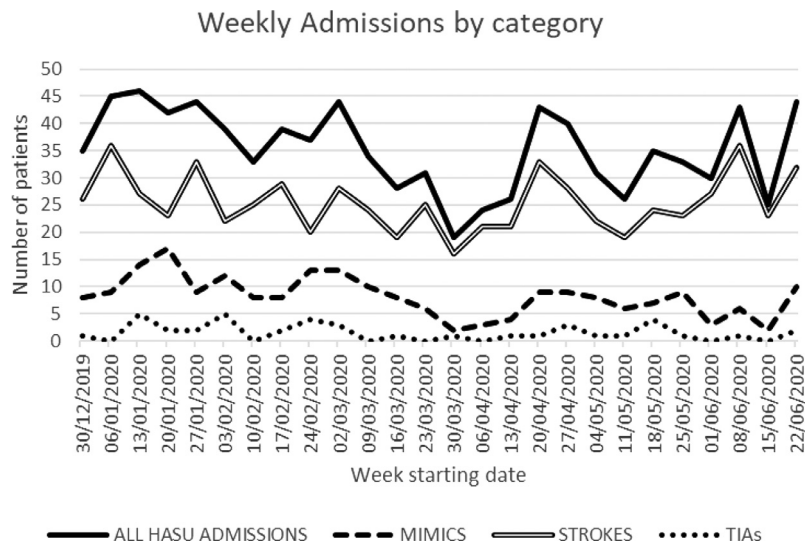


Fig. 1. Weekly admissions to the HyperAcute Stroke Unit by category: mimics, strokes and TIAs.

Similarly, the numbers of patients sent for thrombectomy saw a fall. We were unable to compare these figures with 2019 as this service was not fully available then. In January and February 2020 a mean of 1.2 patients per week were sent for thrombectomy, falling to just 0.4 per week for March, April and May. There were barriers to transfer to the neuro-interventional centre including increased pressure on intensive care beds and concern about inter-hospital transfers of patients who might have COVID-19. (Fig. 1).

Overall length of stay increased non-significantly from 7.5 days (IQR 3.2-22.7), 2019 to 8.2 days (IQR 2.9-22.4), 2020.

The first positive COVID-19 polymerase chain reaction (PCR) nasal swab result on the HASU was on 15th March 2020. During the following week, 11 patients had positive swabs. From then through to the end of April, four new positive cases per week amongst stroke inpatients were detected (Fig. 2). However the numbers diagnosed with COVID-19 sharply dropped after this, with only four positive results from the unit during May. Of the 40 HASU

patients in March, April and May who had confirmed COVID-19, just over half (21, 52.5%) were PCR positive within the first seven days after admission.

Discussion

Some patients were clearly admitted with COVID-19, but in other cases it is not as clear. UK guidance during the peak of the pandemic was that only patients who were admitted with respiratory symptoms were tested for COVID-19. Some patients may have had COVID-19 with no respiratory symptoms and not been tested until they developed them later and some may have contracted the virus in hospital. There is mounting evidence that COVID-19 causes prothrombotic effects⁶ and may cause ischaemic (and also possibly haemorrhagic) strokes. For those who tested positive within a few days of presentation, COVID-19 may have been a causative factor, whereas a positive test later in a prolonged inpatient stay is more likely to suggest inpatient infection. If COVID-19

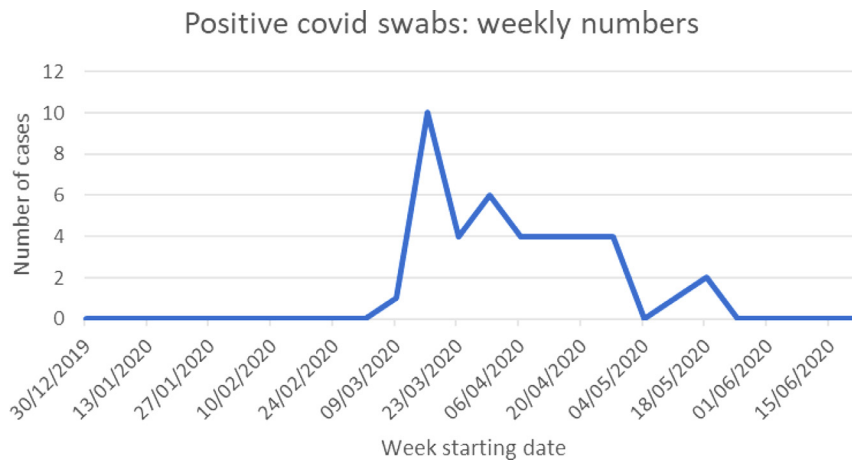


Fig. 2. Weekly number of positive COVID-19 swabs results on the Stroke Unit.

contributed to any of the strokes admitted to our HASU, these did not result in an increase in the overall caseload, as their impact was overwhelmingly reduced by the overall reduction in stroke presentations and admissions.

During the months affected by COVID, time between symptom onset and arrival at hospital was longer. This is not surprising as the ambulance service was very stretched and response times were increased. We are also not surprised that arrival time to first CT and consequently door-to-needle time for thrombolysis were prolonged: it was not possible to use the CT scanner in our emergency room and patients had to be taken to the main radiology department, a journey of about ten minutes.

However, there was no evidence of a change in the severity of strokes, nor other measures of quality of care.

Whilst the reason for the reduced admissions we have experienced is not clear, the cause is likely to be multifactorial. Patients who had strokes may simply have stayed at home because of fear of coming to hospital. We are the main stroke centre for the catchment area and have seen no evidence of this in increasing telephone consultations, referrals to outpatient services or requests for advice by family practitioners but it remains a possibility.

There are documented links between stroke incidence and seasonal temperatures,^{7,8} air pollution⁹ and stress levels.¹⁰ There have been changes to these during the lockdown, with unseasonably warm weather through much of April and May 2020 and reductions in air pollution. Stress, a risk factor for both strokes and functional presentations, is much harder to analyse, and may have been affected in a variety of ways by the socioeconomic effects of the lockdown.

The lockdown in the UK starting 23rd March 2020, may have played a part in the decrease in stroke presentations. However, numerous measures had already been put in place before lockdown to combat viral spread and at least some of the above-mentioned factors may already have been affecting stroke presentations.

Conclusion

We describe the effects on stroke admission numbers of the COVID-19 pandemic in a HASU in London. The drop in stroke case numbers allowed valuable resources to be re-tasked to deal with COVID-19. Resurgences in COVID-19 may occur in the future and may or may not be associated with a similar reduction in stroke admissions. COVID resurgence coinciding with the usual increase in

stroke in winter months would increase pressure on health services.

Declaration of Competing Interest

None.

Ethical Standard Statement

The data reported are collected routinely as part of national auditing of stroke care in the United Kingdom. Therefore the data collection did not require formal ethical review.

Sources of Funding

None.

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