

# Decline in spontaneous cervical artery dissection incidence during COVID-19 public health measures: Evidence for a role of upper respiratory infections in pathogenesis

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## Abstract

**Background:** Upper respiratory infections have been suggested as a risk factor for spontaneous cervical artery dissection (sCeAD). If this is the case, public health measures implemented to contain the spread of SARS-CoV-2, which also reduced other communicable diseases such as influenza, might be associated with a reduction in cervical artery dissection incidence.

**Aims:** We determined the incidence of sCeAD before, during and after the COVID-19 pandemic, and the associated public health measures.

**Methods:** All patients suffering an sCeAD and seen in Innsbruck Austria, between January 2002 to December 2016 (pre-COVID comparators) and between January 2020 to August 2022 were recorded through two individual prospective cohort studies. We compared admission rates, demographic, and clinical characteristics of sCeAD patients in pre-COVID-19 and COVID-19 times.

**Results:** In total, 249 sCeAD patients were admitted prior to the COVID-19 pandemic compared to 20 during its course. Baseline characteristics of sCeAD subjects did not differ in subjects admitted during and prior to the pandemic. Following the introduction of public health measures for the pandemic, there was a marked decrease of sCeAD admissions from 16.5 per year to 6.3 per year ( $p=0.012$ ). Since the measures were ended the number of sCeAD admissions increased again. In contrast, the number of all ischemic stroke patients treated at the Medical University of Innsbruck did not alter during the pandemic. (N per year: 633 in 2015, 687 in 2017, 684 in 2019, 731 in 2020, and 717 in 2021).

**Conclusion:** The incidence of sCeAD fell markedly during the pandemic and this may have resulted from the public health measures introduced and a subsequent reduction in upper respiratory infections. Our study provides indirect evidence for a role of infection in the pathogenesis of sCeAD.

**Data access statement:** Anonymized data not published within this article will be made available by request from any qualified investigator.

## Keywords

COVID-19, measures, cervical artery dissection, stroke

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## Introduction

Measures to contain the spread of SARS-CoV-2 have had an impact on acute management of vascular emergencies globally.<sup>1–8</sup> In turn, these measures, be they lockdown periods or face mask-mandates, have, at least intermittently, hit their mark in preventing the virus spread.<sup>9</sup> As the months

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went on during the COVID-19 pandemic, these public health interventions did not completely disappear and subsequently assisted in the regional decrease of other communicable diseases such as influenza and other upper respiratory infections.<sup>10–12</sup> To date, little is known about the effect that a decreased incidence of respiratory infection has on other, possibly patho-physiologically associated diseases. Although its pathogenesis remains poorly understood, spontaneous cervical artery dissections (sCeAD) has been linked to seasonal variability and upper respiratory infections.<sup>13–15</sup> More recently, case reports have suggested that COVID-19 infection itself may increase the risk of sCeAD in the subacute phase.<sup>16</sup>

## Aims and/or hypothesis

As our population-based database on stroke care in the Tyrol, the Tyrol Stroke Pathway database, revealed that stroke care and admissions remained unaffected by the COVID-19 pandemic and subsequent public-health measures (Mayer-Suess, MD, PhD, unpublished data, 2022), we are uniquely able to reassess the seasonal variability and inter-play between respiratory infection on sCeAD-occurrence by comparing pre-public health intervention-COVID-19 years to 2020, 2021, and 2022.

## Methods

### Patient recruitment and selection

Details on the ReSect-study have been published previously.<sup>17–20</sup> In short, the ReSect-study included all patients with sCeAD treated at the Medical University of Innsbruck from 1996 to 2016. All of ReSect-subjects were invited to a standardized in-house study-specific follow-up visit, 1 year after dissection event at the earliest. From mid-2019 onwards, the ProSect-registry records and periodically follows each patients with sCeAD treated at the Medical University of Innsbruck. The inclusion and exclusion criteria of ProSect-registry mirror the stringent criteria of the ReSect-study, which include a mandatory visualization of vessel wall hematoma in T1-fat-saturated magnetic resonance imaging (MRI) and no timely association to major head/neck-trauma. To adequately address the objectives of our study, the patients of ReSect and ProSect were pooled. Furthermore, only years where complete data were available from January to December were included in the analysis. For absolute number of ischemic stroke patients over the years, we applied the population-based Tyrolean Stroke Pathway database, one of the very few population-based registries worldwide that covers information on all stroke patients in a region irrespective of the treating hospital or department, has full data monitoring and no missing data.<sup>21</sup>

### Variable definitions and statistical methodology

Cerebral ischemia encompasses transient ischemic attacks and ischemic strokes. The seasons are defined as follows: (1) Spring: March 1 to May 31, (2) Summer: June 1 to August 31, (3) Fall: September 1 to November 30, (4) Winter: December 1 to February 28 (February 29 in a leap year). Categorical variables were compared across groups using  $\chi^2$  test. Continuous variables were compared by means of Mann–Whitney U or t-test. Differences in mean sCeAD admissions were calculated by two-sided unpaired t-test.

### Standard protocol approvals, registration, and patient consents

All analyses were approved by the local ethics committee at the Medical University Innsbruck (ReSect #325/2013, ProSect #1240/2018) and appropriate informed consent of patients who took part in the ReSect and ProSect studies was obtained.

### Data availability

Study data that support the findings of this study are available from the corresponding author upon reasonable request after ethics approval and receipt of a signed material transfer agreement.

## Results

Baseline characteristics of sCeAD subjects did not differ in subjects admitted during the COVID-19 pandemic compared to those admitted prior (Table 1).

A marked decrease of sCeAD admissions during 2020, 2021, and the beginning of 2022 could be observed (Figure 1). The per-year mean sCeAD admissions decreased from 16.5 in comparator years to 6.3 ( $p=0.012$ ) during COVID-19. In contrast, the absolute number of ischemic stroke patients treated at the Medical University of Innsbruck did not according to the population-based data from the Tyrolean Stroke Pathway database (N per year: 633 in 2015, 687 in 2017, 684 in 2019, 731 in 2020, and 717 in 2021). Within the first 3 months after public health measure termination, a total of 6 sCeAD patients were admitted, already equalizing the per year mean admission rate during the COVID-pandemic. In line with previous reports, we detected a slight seasonal variability with subjects most frequently suffering sCeAD within months of winter and spring in pre-COVID-19 comparator years. This seasonal variability of sCeAD diagnoses was significantly different in COVID-19 times ( $p=0.036$ ).

## Discussion

Through our comprehensive assessment within the ReSect and ProSect studies, which encompass more than 15 years

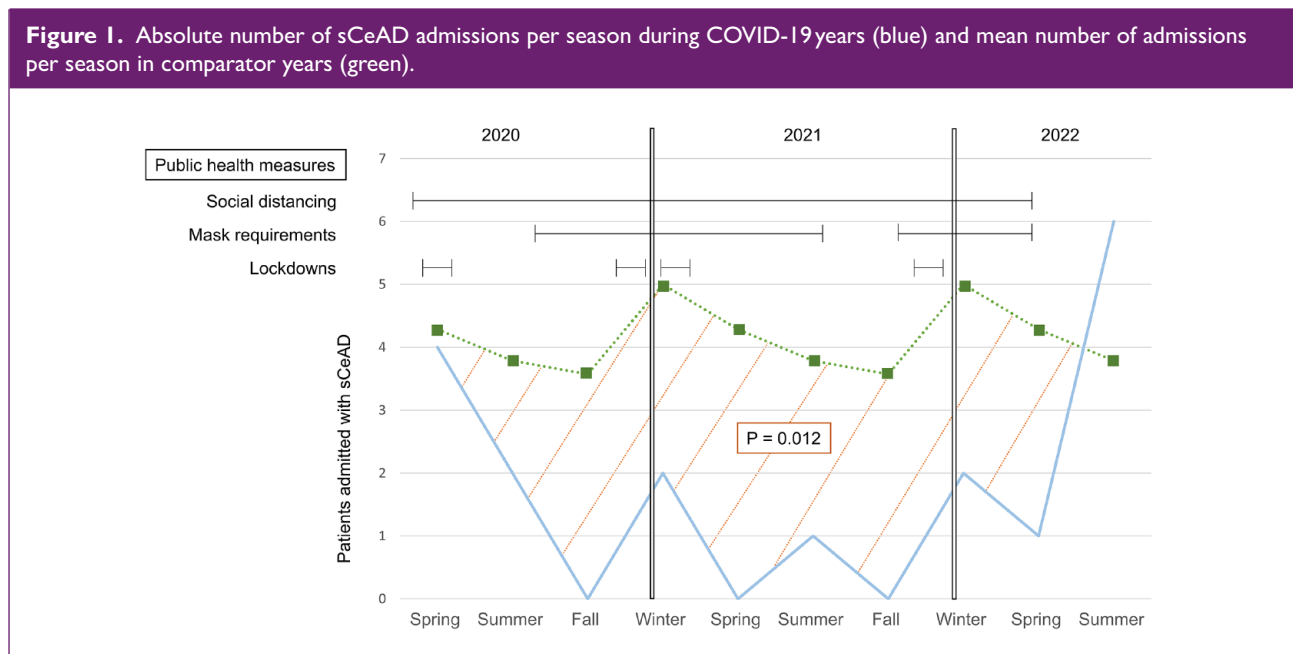
**Table 1.** Differences between patients suffering sCeAD pre-COVID-19 and during the COVID-19 pandemic.

	Pre-COVID-19 (2002–2016)	COVID-19 (2020–2022)	p-value
Baseline characteristics			
N	249	20	
Female*	98 (39.4)	12 (60.0)	0.07
Age†	44.0 (15)	44.0 (15.75)	0.940
Dissected vessel known—N	241	20	0.234
Internal carotid*	113 (46.9)	13 (65.0)	
Vertebral artery*	120 (49.8)	6 (30.0)	
Both*	8 (3.3)	1 (5.0)	
Ischemia*	176 (70.7)	11 (55.0)	0.143
NIHSS†	1 (2.5)	0 (5)	0.660
Season*			0.036
Spring	66 (26.5)	5 (25.0)	
Summer	55 (22.1)	9 (45.0)	
Fall	55 (22.1)	0 (0.0)	
Winter	73 (29.3)	6 (30.0)	

sCeAD: spontaneous cervical artery dissection; COVID-19: coronavirus disease; NIHSS: National Institute of Health Stroke Scale.

\*Values given as N (%)—p-value by means of  $\chi^2$  test.

†Values given as median (IQR)—p-value by means of Mann–Whitney U test.



of data, we report a marked decline of sCeAD admissions during the COVID-19 pandemic. This would be consistent with infections playing a role in the pathogenesis of sCeAD.

An alternative explanation is that symptomatic sCeAD patients did not seek medical attention during the pandemic, but our analyses suggested this is not the case. First,

the Tyrol, a federal state of Austria, was one of the only regions globally that did not see a decrease in major and minor stroke admissions or decline in quality measures of stroke management during COVID-19. (Mayer-Suess, MD, PhD, unpublished data, 2022) This is supported by our analysis in this article showing no change in the total annual number of ischemic stroke cases during the pandemic, compared with pre-pandemic years. Second, as previously reported, sCeAD patients are most likely to seek medical attention at the time of cerebral ischemia, but half of the subjects suffering sCeAD during COVID-19 had local symptoms only.<sup>17</sup> Furthermore, even though the validity of data may be limited due to the low absolute number of sCeAD subjects in 2020, 2021, and 2022 (the main point made by our analysis), baseline and clinical characteristics did not differ to comparator years prior to the pandemic. Third, the return in the number of sCeAD admissions to pre-pandemic numbers when the public health measures were ended would be consistent with our interpretation.

Although our data does not prove a causal relationship, it would be consistent with a role of infection in the risk of sCeAD. It is possible this could add by providing an additive risk through inflammation in patients with prior susceptibility for sCeAD (i.e. those with prior sub-clinically evident connective tissue aberrations or a genetic predisposition).<sup>18</sup> This mechanism warrants further investigation.



### Declaration of conflicting interests

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### References

- Nogueira RG, Qureshi MM, Abdalkader M, et al. Global impact of COVID-19 on stroke care and IV thrombolysis. *Neurology* 2021; 96: e2824–e2838.
- Richter D, Eyding J, Weber R, et al. Analysis of nationwide stroke patient care in times of COVID-19 pandemic in Germany. *Stroke* 2021; 52: 716–721.
- Douiri A, Muruet W, Bhalla A, et al. Stroke care in the United Kingdom during the COVID-19 pandemic. *Stroke* 2021; 52: 2125–2133.
- Zhao J, Li H, Kung D, et al. Impact of the COVID-19 epidemic on stroke care and potential solutions. *Stroke* 2020; 51: 1996–2001.
- Solomon MD, Nguyen-Huynh M, Leong TK, et al. Changes in patterns of hospital visits for acute myocardial infarction or ischemic stroke during COVID-19 surges. *JAMA* 2021; 326: 82–84.
- Bhambhani HP, Rodrigues AJ, Yu JS, et al. Hospital volumes of 5 medical emergencies in the COVID-19 pandemic in 2 US medical centers. *JAMA Intern Med* 2021; 181: 272–274.
- Altersberger VL, Stolze LJ, Heldner MR, et al. Maintenance of acute stroke care service during the COVID-19 pandemic lockdown. *Stroke* 2021; 52: 1693–1701.
- Mariet AS, Giroud M, Benzenine E, et al. Hospitalizations for stroke in France during the COVID-19 pandemic before, during, and after the national lockdown. *Stroke* 2021; 52: 1362–1369.
- Talic S, Shah S, Wild H, et al. Effectiveness of public health measures in reducing the incidence of covid-19, SARS-CoV-2 transmission, and covid-19 mortality: systematic review and meta-analysis. *BMJ* 2021; 375: e068302.
- Doroshenko A, Lee N, MacDonald C, et al. Decline of influenza and respiratory viruses with COVID-19 public health measures: Alberta, Canada. *Mayo Clin Proc* 2021; 96: 3042–3052.
- Jones N. How coronavirus lockdowns stopped flu in its tracks. *Nature*. Epub ahead of print 21 May 2020. DOI: 10.1038/d41586-020-01538-8.
- Servick K. COVID-19 measures also suppress flu-for now. *Science* 2021; 371: 224.
- Hunter MD, Moon YP, Miller EC, et al. Influenza-like illness is associated with increased short-term risk of cervical artery dissection. *J Stroke Cerebrovasc Dis* 2021; 30: 105490.
- Paciaroni M, Georgiadis D, Arnold M, et al. Seasonal variability in spontaneous cervical artery dissection. *J Neurol Neurosurg Psychiatry* 2006; 77: 677–679.
- Schievink WI, Wijdicks EF and Kuiper JD. Seasonal pattern of spontaneous cervical artery dissection. *J Neurosurg* 1998; 89: 101–103.
- Purdy K, Long R and Jickling G. Case report: COVID-19 infection and cervical artery dissection. *Am J Trop Med Hyg* 2022; 106: 874–876.
- Mayer L, Boehme C, Toell T, et al. Local signs and symptoms in spontaneous cervical artery dissection: a single centre cohort study. *J Stroke* 2019; 21: 112–115.
- Mayer L, Pechlaner R, Barallobre-Barreiro J, et al. Extracellular matrix protein signature of recurrent spontaneous cervical artery dissection. *Neurology* 2020; 95: e2047–e2055.
- Mayer-Suess L, Geiger M, Dejakum B, et al. Sex-differences in psychosocial sequelae after spontaneous cervical artery dissection. *Sci Rep* 2022; 12: 611.
- Mayer-Suess L, Frank F, Töll T, et al. Head/neck pain characteristics after spontaneous cervical artery dissection in the acute phase and on a long-run. *Cephalalgia* 2022; 42: 872–878.
- Willeit J, Geley T, Schöch J, et al. Thrombolysis and clinical outcome in patients with stroke after implementation of the Tyrol Stroke Pathway: a retrospective observational study. *Lancet Neurol* 2015; 14: 48–56.