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COVID-19 Testing in Patients with Vascular Disorders - A Prospective Cohort Study at a Tertiary Care Hospital in Austria

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Abstract

Background: To investigate the prevalence of SARS-CoV-2 infection in hospitalized patients with vascular disorders after implementing institutional and governmental safety measures in Austria.

Methods: Vascular Patients (VPs) admitted to our tertiary care hospital were routinely tested for SARS-CoV-2 infection on a two days basis between March and December, 2020. The prevalence of SARS-CoV-2 was compared between VPs and two independent Austrian populations. The results were also compared to a cohort of Health Care Personnel (HCP) working in close proximity to the study patients, tested weekly, between March and December, 2020.

Results: A total of five (0.2%) SARS-CoV-2 positive patients were detected out of 2,243 included patients. The proportion of SARS-CoV-2 infected patients during the first lockdown, post lockdown, and second lockdown was 0.34%, 0.17%, and 0.49% respectively. The estimated risk ratio for SARS-CoV-2 prevalence between the VPs and the general population was 0.05% (95% CI, 0.02% to 0.17%) during the second lockdown ($p<0.0001$). In 22 (5%) out of 441 members of the HCP cohort, SARS-CoV-2 infection was detected. However, no contagion has been observed between study patients and HCP during the entire observational period.

Conclusion: Our study provides evidence of SARS-CoV-2 prevalence in Austrian patients with vascular disorders. VPs were less often infected than the general population. Thus, we demonstrate that continuous patient treatment and follow-up visits in a large tertiary care hospital during the pandemic are reasonable when in compliance with the common safety precautions. Routine SARS-CoV-2 testing of patients with vascular disorders is advisable to detect asymptomatic patients and avoid uncontrolled viral spread.

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Introduction

There is increasing evidence that Vascular Patients (VPs), especially those with Cardiac Disorders (CD), diabetes, and hypertension, are at greater risk for severe COVID-19 infection and suffer higher mortality [1]. According to the World Health Organization (WHO), the estimated worldwide mortality rate for SARS-CoV-2 is at least 4%. In contrast, the Austrian population's mortality rate is 2.7% and is highest amongst older adults (>65 years) and critically ill patients [2,3]. However, while the estimated prevalence of SARS-CoV-2 is 3.1% among the non-hospitalized population in Austria scarce evidence exists regarding SARS-CoV-2 prevalence among patients with vascular disorders in the Western population [4].

During the first lockdown period in Austria, significant changes were implemented in daily clinical practice to counteract viral spread: Outpatient appointments were postponed, elective surgeries rescheduled, and only emergency surgeries performed. Those strict measures were gradually rolled back during the post lockdown period. In addition, institutional safety measures were implemented within the Medical University of Vienna, including the use of Personal Protective Equipment (PPE), restrictions in work-related travel and contacts, and limitations on patient access.

Unfortunately, those measures, also had significant consequences on the clinical outcome of patients with advanced vascular disorders regardless of SARS-CoV-2 infection status [5,6]. Therefore, it is vital to determine the true prevalence of SARS-CoV-2 infection in patients with vascular disorders compared to that of the general population after implementation of governmental safety measures in Austria.

Approximately 41% of all SARS-CoV-2 cases in Wuhan/China have been caused by nosocomial transmission [7]. Furthermore, 9% of Health Care Personnel (HCP) in Italy have been reportedly infected with SARS-CoV-2 [8]. In this study, we aimed to assess the SARS-CoV-2 infection prevalence among HCP working in close proximity to admitted patients to determine if contagion occurred between HCP and VP in our large tertiary care hospital in Vienna, Austria after implementation of institutional safety measures.

Materials and Methods

This study employed a prospective single-center, observational cohort design at a large tertiary care hospital (Departments of General Surgery, Division of Vascular Surgery and Department of Internal Medicine). We investigated clinical data from all patients presenting at the hospital with vascular disorders, including Peripheral Artery Disease (PAD), Cardiac Disorders (CD), Aortic Aneurysm (AA), Extracranial Artery Disorders (EAD) and Venous Disorders (VD). All patients' private information was de-identified by giving them a number after data collection.

We routinely tested for SARS-CoV-2 between March 16th and December 07th, 2020. The first lockdown in Austria was implemented from March 16th to May 04th, 2020. We defined the time from May 05th to November 16th, 2020, as the post-lockdown period. The second lockdown was implemented from November 17th to December 07th, 2020. This study was approved by the ethics committee of the Medical University of Vienna (EC2049/2020) and conducted according to the principles of the Helsinki Declaration and Good Clinical Practice. In addition, this study has been reported in accordance with the STROCSS criteria and guidelines [9].

Primary and secondary endpoints

The primary endpoint of the present study was to determine the prevalence and incidence of SARS-CoV-2 infection in patients with vascular disease after the implementation of institutional and governmental safety measures and compared it to SARS-CoV-2 infections among the general population in Austria.

The secondary endpoint was to assess the occurrence of SARS-CoV-2 infection among HCP workers (in close proximity to the admitted patients and routinely tested for SARS-CoV-2) after implementing institutional safety measures to evaluate viral transmission between HCP and VP.

Cohorts

We compiled the following groups:

Patient cohort: All patients with vascular disorders consecutively admitted at our tertiary care hospital from March 16th to December 07th, 2020.

Control cohort: Data of two nationwide PCR-based studies conducted in a representative random sample, from April 01st to 06th, and November 12th to 14th, 2020, collected by the Austrian Ministry of Science and the Austrian Red Cross to estimate the spread of SARS-CoV-2 infection among the non-hospitalized Austrian population [10,11].

HCP cohort: HCP worker data, including nurses, nurse technicians, physicians, surgical personal, physical therapists, nurse practitioners, environmental service workers, administrative staff, and dietitians, working in close proximity to admitted patients at our tertiary care hospital from March 16th to December 07th, 2020.

SARS-CoV-2 testing

Beginning in March 2020, nasal or pharyngeal respiratory swabs were routinely taken of each patient admitted at our departments and repeated regularly at 48 h intervals during the inpatient stay. In the HCP cohort testing for SARS-CoV-2 RNA was performed, on a weekly basis, at the Department of Laboratory Medicine, Medical University of Vienna, Austria, using Real-Time Polymerase Chain Reaction (RT-PCR). Comparability of the results of all test methods used was confirmed by participation in international quality control ring trials [12]. In the HCP cohort testing for SARS-CoV-2 RNA was performed until November, 2020 and since then RT-PCR was only used to confirm positive results of antigen testing.

Statistics

Statistical analyses were performed using IBM SPSS© Statistics for iOS, version 25 (IBM Corp. Chicago, Ill., USA) and SAS©, Version 9.4 (SAS Institute Inc, Cary, NC, USA). Continuous variables are described by median, minimum and maximum. Categorical variables are presented as frequencies and percentages and corresponding 95% Confidence Intervals (95% CI) are calculated according to the method of Wilson. Group differences of binary variables were tested χ^2 test or Fisher's exact test in case of sparse data. Estimation and group comparisons of incidence rates and corresponding confidence intervals were performed by a generalized linear model with log-link and Poisson distribution also accounting for the weeks under observation. A two-sided p-value ≤ .05 was considered statistically significant.

Results

Patient characteristics

Within the observation period between March 16th and December 07th, 2020, a total of 2,243 patients (1,336 [60%] men and 907 [40%] women, with a median age of 70 years and various vascular disorders were admitted to our hospital departments. Patient characteristics are presented in Table 1. The most common causes for inpatient admission were CD, including atherosclerotic, valvular, and ischemic heart disease (692 [31%]), non-vascular complaints in VPs (691 [31%]), followed by PAD (611 [27%]). All elective admissions occurred a week after one or more outpatient hospital visits. Out of 2,240 patients with relevant comorbidities, 994 (44%) cases were co-diagnosed with endocrinological disorders such as diabetes and thyroid disorders, and 903 (40%) with cardiac comorbidities.

SARS-CoV-2 infection

During the observational period, a total of five SARS-CoV-2 infections were detected, three in men and two in women. In one asymptomatic patient with EAD, SARS-CoV-2 was detected a day before the elective admission, and the admission as well as the planned intervention was postponed. In two other cases, an asymptomatic infection was detected two days after the elective admission. Both noticed only a mild fever. Two symptomatic cases were admitted to an acute setting with confirmed SARS-CoV-2 infection. One patient was found to have an acute myocardial infarction, and one patient

Table 1: Clinical and SARS-CoV-2 related characteristics of patients with vascular disorders.

Pat. Characteristics	Pandemic Period March to Dec. 2020	First LD March to May 2020	Post-LD May to Nov. 2020	Second LD Nov. to Dec. 2020
Characteristics				
Nr. of patients	n=2243	n=290	n=1751	n=202
Gender				
Male	1336 (60%)	178 (61%)	1030 (59%)	128 (63%)
Female	907 (40%)	112 (39%)	721 (41%)	74 (37%)
Age in Years (Range)	70 (18-100)	71 (22-100)	70 (18-97)	70 (29-94)
Diagnosis				
Extracranial artery disorder	80 (4%)	6 (2%)	64 (4%)	10 (5%)
Cardiac disorder	692 (31%)	79 (27%)	553 (32%)	60(30%)
Aortic aneurysm	135 (6%)	19 (7%)	104 (6%)	12 (6%)
Peripheral artery disease	611 (27%)	94 (32%)	466 (27%)	51 (25%)
Venous Disorder	34 (1%)	4 (1%)	24 (1%)	6 (3%)
Others	691 (31%)	88 (30%)	540 (31%)	63 (31%)
Co-Morbidities				
Oncological	167 (7%)	25 (9%)	124 (7%)	18 (9%)
Cardiac	903 (40%)	114 (39%)	687 (39%)	102 (50%)
Endocrinological	994 (44%)	7 (1%)	5 (6%)	17 (5%)
Pulmonal	138 (6%)	134 (46%)	800 (46%)	60 (30%)
Psychiatric	38 (2%)	4 (1%)	29 (2%)	5 (2%)
SARS-CoV-2 Positive Patients	5 (0.2%)	1 (0.3%)	3 (0.2%)	1(0.5%)

Categorical variables are presented as frequencies and percentages. Continuous variables are presented as median with minimum and maximum. LD: Lockdown; Others: vascular patients with other diseases (for example inguinal hernia…)

was in critical condition with respiratory distress in urgent need of extracorporeal membrane oxygenation. They were co-diagnosed with coronary artery disease and pulmonary comorbidities. No SARS-CoV-2 related deaths were observed, and all five patients achieved viral clearance (PCR cycle threshold >35) 12 to 27 days after testing positive.

The proportion of patients with positive results during the first lockdown period was 0.34% (95% CI, 0.06% and 1.9%). The calculated proportion for the post lockdown period was 0.17% (95% CI, 0.05% to 0.5%) and for the second lockdown period was 0.50% (95% CI, 0.09% to 2.75%). The proportion of patient with positive result during the whole observational period is 0.22% (95% CI, 0.10% to 0.52%), but only 3 of these patients were positively tested at admission, that is a proportion of 0.13% (95% CI, 0.05% to 0.39%).

Control cohort

April 01st to 06th, 2020, 1,544 non-hospitalized Austrian people underwent a PCR test for SARS-CoV-2 infection. Six participants were positive with no cardiovascular-related comorbidity. The proportion of participants with positive results was 0.39% (95% CI, 0.18% to 0.85%). Comparing that April population study to the proportion of positively tested VPs in the first lockdown 2020, 0.34% (95% CI, 0.06% to 1.9%), the risk ratio of VPs was 0.89 (95% CI, 0.11% to 7.34%) (p=1.0).

November 12th to 14th, 2020, 2,263 non-hospitalized Austrian people were tested by PCR for SARS-CoV-2 infection. Only 72 participants tested positive. The proportion of participants with a positive test was 3.2% (95% CI, 2.5% to 4.0%). Comparing that November study population with the proportion of positively tested VPs in the post lockdown period, 0.17%, the estimated risk ratio of VPs was 0.05% (95% CI, 0.02% to 0.17%) (p<0.0001).

Table 2: Characteristics of health care personnel working in close proximity to vascular patients.

Health Care Personnel Characteristics	
Nr. of Participants	n=441
Nr. Tests Performed	14553
Gender	
Male	159 (36%)
Female	282 (64%)
Age in Years (Range)	43 (20-67)
Profession	
Physician	160 (36%)
Nurse and co.	281 (64%)
SARS-CoV-2 Test Results	
Positive	22 (5%)
Negative	419 (95%)

Categorical variables are presented as frequencies and percentages. Continuous variables are presented as means with minimum and maximum

Healthcare personnel cohort

The HCP cohort consisted of 441 participants. Baseline characteristics are provided in Table 2. From March to December 2020, 14,553 PCR tests performed, on a weekly basis, confirmed SARS-CoV-2 infection in 17 nurses and five physicians/medical students with no travel history and without any comorbidities. Nevertheless, all 22 HCP were required to participate in an immediate at-home quarantine, which was enforced until they tested negative.

The proportion of positively tested HCP was 4.99% (95% CI,

3.32% to 7.44%) over the observational period. Considering the long time under investigation of HCP the 7-day incidence rate of HCP is 0.15 (95% CI, 0.10 to 0.23). Considering also the observation time of VPs during the COVID-19 pandemic in 2020 of 3,845, 9 weeks for all patients, that is 1.7 weeks on average, the 7-day incidence rate is 0.13 (95% CI, 0.05 to 0.31) resulting in a decreased relative risk of VPs of 0.86 (95% CI, 0.33 to 2.27) compared to HCP (p=0.7608).

Discussion

Our data reveal systematic evidence of SARS-CoV-2 prevalence in Austrian patients with severe vascular disorders, including prevalence after the implementation of safety measures. We noticed a significantly lower infection in VPs than in the general population during the post lock-down period 2020. We also observed an insignificantly lower seven-day incidence rate in VPs (0.13) compared to the respective HCP (0.15). Moreover, the infection rate remained quite stable between the observational periods of the first lockdown (0.3%), post lockdown (0.2%), and second lockdown (0.5%), indicating the effect of strict lockdowns on infections in VPs was marginal. This is consistent with data demonstrated by Bendavid et al. [13], where no significant benefits on infection case growth have been found after implementing of mandatory lockdowns.

Patients in general and VPs, in particular, are exposed to unavoidable social contacts, including those in the hospital outpatient environment and medical station. More specifically, in centers with high patient turnover, the concern for contagion during the pandemic has been a leading factor keeping patients away from visiting hospitals. To date, a higher rate of SARS-CoV-2 infection with a poorer clinical outcome has been reported in patients with cardiovascular disease [14]. Emerging evidence indicates that hypertension, diabetes, and cardiovascular diseases are the most prevalent comorbidities observed in SARS-CoV-2 infected patients [15]. One study noted an association between pre-existing vascular disorders and severe clinical outcomes with a higher ICU death rate of 63% [16]. Others have suggested increased SARS-CoV-2 related mortality in patients with cardiovascular diseases [17]. We found in the current study that VPs were not more severely affected by SARS-CoV-2 than the general population, indicating an equivalent or even decreased susceptibility of VPs to SARS-CoV-2 infection.

Notably, the control cohorts were unselected populations sampled during limited time periods. Therefore, they may not be a perfect demographic match to the patient cohort. Thus, we thought to analyses the HCP cohort with direct patient contact as a third group. However, a lower incidence rate and the zero number of at hospital contagion indicate that VPs were not considerably affected by positive SARS-CoV-2 HCPs. This result is consistent with data provided by Fuereder et al., in which the infection risk was not higher among oncological patients (2.4%) despite the given odds for higher infection prevalence among respective HCP (3.2%) [18].

Notably, we did not observe any infection among PAD patients. This might be due to unregistered at-home SARS-CoV-2 infections as a consequence of restrictive measures or fear of contagion that prevented outpatient presentation, especially during the first lockdown; or possibly just because this patient population is less susceptible to SARS-CoV-2 infection than expected. However, further investigations are necessary to address this matter with larger patient cohorts.

Nevertheless, from our perspective, the continuous evolution of smart safety measures, including wearing masks, is the most effective strategy to prevent uncontrolled viral spread within the healthcare setting. Strict measures such as reducing operation capacities and creating empty operation rooms in preparation for a worsening crisis may be unnecessary [19]. These practices may even harm patients due to extreme waiting lists.

Conclusion

Our study provides systematic evidence on SARS-CoV-2 prevalence in Austrian patients with severe vascular disorders. We observed a comparatively lower susceptibility of VPs to SARS-CoV-2 infection than the general population. Thus, it seems reasonable to provide continuous patient treatment and follow-up visits in a large tertiary care hospital when in compliance with the common pandemic safety precautions. Routine SARS-CoV-2 testing of patients with vascular disorders seems advisable to detect asymptomatic virus carriers and avoid uncontrolled viral spread. This information is necessary for decision-makers and public safety policies implemented within critical infrastructure such as hospitals.

Author Contributions

Kasiri MM.: Conception and Design, Methodology, Data Collection, Analysis, Writing the Manuscript; Mittlboeck M.: Methodology, Statistical Analysis and Interpretation, Critical Revision, Editing and Approval of the Manuscript; Giurgea GA.: Data Collection, Validation and Writing a Draft; Fortner N.: Data Collection, Reviewing and Editing, Providing Resources; Lirk P.: Formal Analysis, Writing- Reviewing and Editing; Eilenberg W.: Data Validation; Neumayer C.: Supervision, Analysis and Interpretation, Critical Revision, Approval of the Manuscript; Gollackner B.: Supervision, Analysis and Interpretation, Critical Revision, Approval of the Manuscript.

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