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Association of Acute COVID-19 with 24 Hours-Pulse Wave Velocity in Cameroonian Workers

Association entre infection aigue à COVID – 19 et vitesse de l'onde pouls sur 24 heures chez les travailleurs camerounais

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ABSTRACT

Introduction. COVID-19 appears to have a vascular tropism responsible for diffuse vasculitis-like cell damage. The aim of our study was to evaluate the impact of Sars-Cov-2 infection on arterial stiffness. **Material and methods**. This was a cross-sectional analytical case-control study with 1:1 matching (1 case to 1 control) over a six-month period from January 1, 2021 to June 30, 2021 at the medical-social center of the autonomous port of Douala. We measured the pulse wave velocity (PWV) in two groups of patients (group 1: COVID-19 and group 2: non-COVID-19) using a MOBIL-O-GRAPH 24h PWA MonitorTM. A p-value < 0.05 was considered significant. **Result**. A total of 122 patients (61 COVID-19 and 61 non-covid) were included in this study, among which 68 (55.7%) male. The mean age was 41±11 years. PWV as well as POV adjusted for age and mean BP were similar in both groups. The mean 24-hour, diurnal and nocturnal PWV were slightly higher in COVID-19 patients than in controls by 0.1 m/s (p=0.67), 0.2m/s (p=0.37) and 0.2m/s (p=0.25) respectively. COVID-19 infection was not significantly associated with PWV (p=0.082). **Conclusion.** PWV were slightly higher in COVID-19 patients and increased arterial stiffness was not significantly associated with COVID-19 status in the acute phase of infection.

RESUME

Introduction. La Covid- 19 semble avoir un tropisme vasculaire responsable des lésions cellulaires semblables à une vascularite diffuse. Le but de notre étude était d'évaluer l'impact de l'infection au Sars-Cov-2 sur la rigidité artérielle. **Matériels et méthodes**. Il s'agissait d'une étude transversale analytique de type cas témoins avec appariement 1/1 (1 cas pour 1 témoin) sur une période six mois allant du 01er Janvier 2021 au 30 Juin 2021, au centre médico-social du port autonome de Douala. Nous avons mesuré la vitesse de propagation de l'onde de pouls (VOP) dans deux groupes de patients (groupe 1 : COVID-19 et groupe 2 : non COVID-19) à l'aide d'un appareil de marque MOBIL-O-GRAPH 24h PWA Monitor™. Une valeur p < 0,05 était considérée significative. **Résultats.** Sur un total de 122 patients (61 COVID-19 et 61 non covid) inclus, 68 (55,7%) de sexe masculin. L'âge moyen était de 41±11 ans. La VOP ainsi que la VOP ajustée à l'âge et à la PA moyenne étaient similaires dans les deux groupes. Les VOP moyennes sur 24h, diurne et nocturne étaient légèrement élevées chez les patients COVID-19 que chez les témoins de 0,1 m/s (p=0.67), 0.2m/s (p=0.37) et 0.2m/s (p=0.25) respectivement. L'infection à COVID-19 n'était pas significativement associée à la VOP (p=0.082). **Conclusion.** Les VOP étaient légèrement plus élevées chez les patients COVID-19 et l'augmentation de la rigidité artérielle n'est pas significativement associée au statut COVID-19 à la phase aiguë de l'infection.

POINTS SAILLANTS

Ce qui est connu du sujet

La COVID- 19 semble avoir un tropisme vasculaire responsable des lésions cellulaires semblables à une vascularite.

La question abordée dans cette étude

Impact de l'infection au Sars-Cov-2 sur la rigidité artérielle chez les travailleurs au Cameroun

Ce que cette étude apporte de nouveau

La rigidité artérielle n'est pas associée au statut COVID-19 chez les travailleurs.

Les implications pour la pratique, les politiques ou les recherches futures.

Des études prospectives permettront de mieux évaluer l'impact à long terme de la COVID 19 sur le risque cardiovasculaire global en Afrique

INTRODUCTION

Since December 2019, the world has been living with a serious health crisis caused by the emergence of a new coronavirus, officially known as severe acute respiratory syndrome coronavirus 2 (SARS-CoV2). Initially isolated in Wuhan, China, this highly contagious virus has spread throughout the world and on 11 March 2020, this epidemic was declared a global pandemic by the World Health Organization (WHO) [1,2]. Although the clinical manifestations are dominated by respiratory symptoms, up to and including acute respiratory distress syndrome (ARDS), cardiovascular involvement has been reported[3]. This can occur either through direct injury of the heart or secondary to the systemic inflammatory state [4]. In addition, this infection has a vascular tropism responsible for cellular lesions similar to diffuse vasculitis, [5]. This may have a significant long-term impact on vascular ageing [6].

Vascular stiffness a major consequence of ageing and is considered an important risk factor for the development of various cardiovascular and cerebrovascular complications [7,8]. It can be measured by the pulse wave velocity (PWV) which is the speed with which the blood wave propagates through an arterial segment [9]. Carotid-femoral pulse wave velocity accurately reflects arterial resistance and is an independent predictor of morbidity and mortality [8,10]. According to the 2013 recommendations of the European Society of Hypertension, an aortic PWV greater than 10m/s predicts an increased risk of cardiovascular events [11]. This measure is hardly used in clinical practice, yet it is crucial for the early detection and management of patients at risk. Although cardiovascular diseases/risk factors such as hypertension, diabetes, obesity, dyslipidaemia, and renal failure are associated with increased arterial stiffness, little is known on the interplay of these risk factors with acute COVID-19 infection on arterial stiffness. We aimed to assess the impact of SARS-COV-2 infection on arterial stiffness as measured by pulse wave velocity (PWV).

PATIENTS AND METHODS

Study setting and design

This was a case-control study with 1:1 matching (1 case for 1 control) carried out from January 1, 2021 to June 30, 2021 at the medical center of the autonomous port of Douala (PAD). This center which takes care of all the employees of the PAD has five doctors and a dozen nurses under the supervision of a head doctor. The PAD is a parapublic company located on the banks of the Wouri River in the city of Douala. Spread over an area of about 1000 hectares, this structure houses a number of subcontracting companies.

Data collection

Patients were included if they had been tested for COVID-19 by polymerase chain reaction (PCR) during the period from January to March 2021 and provided their informed consent. Patients were divided into two groups based on test results: (Group 1: positive and Group 2: negative) for cases and controls respectively. We collected socio-demographic data (age, sex), COVID-19 status, history of risk factors and chronic disease including hypertension, diabetes, heart and kidney disease, blood pressure, weight and height. All patients underwent a 24-hour electrocardiographic recording (24-hour Holter ECG) using a MOBIL-O-GRAPH 24h PWA MonitorTM for pulse wave velocity (PWV) measurement.

Statistical analysis of the data

Data was analyzed using Statistical Package for Social Science (SPSS) version 20.0. Quantitative variables were presented as mean ± standard deviation, median while qualitative variables were presented as numbers (percentages). The t-student test was used to compare means and the chi-square test to compare proportions. Independent determinants of PWV were established using linear and multiple regression. Values were considered significant at a $p<0.05$.

RESULTS

General characteristics of the study population

A total of 122 patients (61 COVID-19 and 61 non-covid) were included in this study, among which 68 (55.7%) males. The mean age was 41±11 years. Systolic, diastolic and mean blood pressures were higher in patients in the COVID-19 group ($p=0.002$, $p=0.003$ and $p<0.0001$ respectively). PWV and PWV adjusted for age and mean BP were similar in both groups. Among the biological parameters, CRP and HDL cholesterol were significantly higher in COVID-19 patients than in controls ($p=0.001$ and $p=0.021$ respectively) (Table I).

Table I: baseline characteristics of the sample

Variables	Total (n=122)	COVID-19 (n=61)	Control (n=61)	p-value
Age (years)	41±11	41±11	41±11	0.916
Male gender (%)	68 (55.7)	34 (55.7)	35 (55.7)	0.716
Height (cm)	170±8	171±9	168±8	0.097
Weight (kg)	83.3±15.9	84.8±15.9	81.7±16.1	0.289
BMI (Kg/m2)	28.9±5.4	29.0±5.1	28.9±5.7	0.852
Overweight/obesity (%)	91(75.2)	47(77.0)	44(73.3)	0.793
Heart rate (bpm)	73±8	73±7	73±8	0.889
Systolic BP (mmHg)	121±11	124±12	118±10	0.002
Diastolic BP (mmHg)	76±9	79±9	74±8	0.003
Mean BP (mmHg)	101±15	109±15	92±9	< 0.0001
Pulse pressure (mmHg)	45±9	45±12	44±6	0.362
PWV (m/s)	6.04±1.21	6.18±1.29	5.89±1.13	0.190
PWV* (m/s)	6.04±0.88	6.05±0.86	6.03±0.91	0.916
PWV(m/s)**	6.04 ±0.89	6.12 ±0.88	5.95 ±0.91	0.283
Creatinemia (mg/l)	10.1±2.80	10.0±2.0	10.1±2.0	0.756
Microalbuminuria (mg/dl)	0.66±0.53	0.61±0.59	0.79±0.32	0.264
CRP (mg/l)	9.3±10.6	12.5±14.2	6.03±2.5	0.001
LDL Cholesterol (g/L)	1.28±0.44	1.35±0.40	1.21±0.47	0.099
HDL Cholesterol (g/L)	0.79±0.31	0.86±0.34	0.73±0.27	0.021
Triglycerides (g/L)	0.68±0.41	0.73±0.32	0.63±0.48	0.199
Blood glucose (g/L)	0.93±0.14	0.91±0.13	0.95±0.14	0.065

BMI: body mass index; BP: blood pressure; PWV: pulse wave velocity; CRP: C-reactive protein; PWV* adjusted for age; PWV**: PWV adjusted for age and mean BP

Variation in 24-hour PWV between cases and controls

The 24-hour, diurnal and nocturnal mean PWV were slightly higher in COVID-19 patients than in controls by 0.1 m/s, 0.2m/s and 0.2m/s respectively (figure 1).

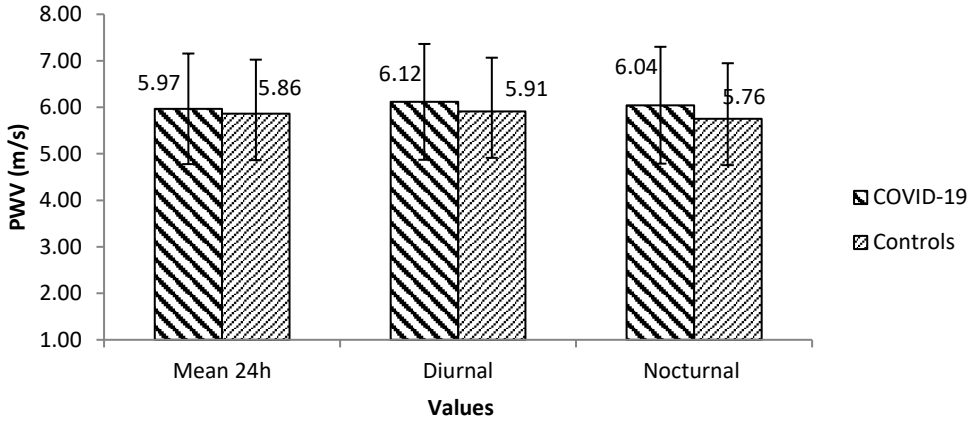

Figure 1: comparison of 24h, diurnal and nocturnal values of PWV between COVID-19 and control patients

For both adjusted and unadjusted mean PWV values, diurnal PWV was significantly elevated in the male control group (p =0.021) (table II).

Table II: gender comparison of 24h, diurnal and nocturnal values of PWV in COVID-19 and control patients

	COVID-19			Controls		
	Female	Male	p-value	Female	Male	p-value
Unadjusted values						
Mean 24h PWV (m/s)	5.66 ±0.98	6.24 ±1.31	0.049	5.62 ±1.11	6.05 ±1.18	0.090
Diurnal PWV (m/s)	5.79 ±0.91	6.42 ±1.44	0.038	5.60 ±1.09	6.14 ±1.16	0.021
Nocturnal PWV (m/s)	5.83 ±0.89	6.23 ±1.50	0.226	5.54 ±1.22	5.92 ±1.17	0.100
Age-adjusted values						
Mean 24h PWV (m/s)	5.74 ±0.79	6.09 ±0.91	0.084	5.75 ±0.88	6.02 ±0.94	0.204
Diurnal PWV (m/s)	5.84 ±0.79	6.19 ±0.91	0.084	5.60 ±1.09	6.14 ±1.16	0.021
Nocturnal PWV (m/s)	5.71 ±0.82	6.09 ±0.94	0.084	5.73 ±0.91	6.01 ±0.98	0.204

COVID-19 was not significantly associated with PWV (p=0.082). In the COVID-19 group, age was significantly associated with PWV (p<0.0001) while in the control group, age and mean BP were significantly associated with PWV (p<0.0001 and p=0.0002 respectively) (Table III).

Table III: univariate and multivariate factors associated with PWV in the population

	Univariate		Multivariate	
Total	**β (IC à 95%)**	**p-value**	**β (IC à 95%)**	**p-value**
Age (years)	0.08 (0.07; 0.09)	< 0.0001	0.07 (0.05; 0.08)	< 0.0001
IMC (kg/m²)	**0.08 (0.05; 0.12)**	**< 0.0001**	**0.04 (0.01; 0.07)**	**0.009**
Mean BP (mmHg)	0.02 (0.01; 0.03)	0.007	0.01 (-0.01 ; 0.02)	0.290
Male (vs female) gender	**0.49 (0.06; 0.92)**	**0.026**	**0.17 (-0.19; 0.53)**	**0.353**
COVID-19 (vs control)	0.29 (-0.15; 0.73)	0.190	0.27 (-0.03; 0.57)	0.082
COVID-19 group				
Age (years)	0.08 (0.06; 0.11)	< 0.0001	0.08 (0.05; 0.10)	< 0.0001
IMC (kg/m²)	**0.09 (0.03; 0.15)**	**0.003**	**0.04 (-0.01 ; 0.09)**	**0.098**
Mean BP (mmHg)	0.01 (-0.01 ; 0.03)	0.500		
Male (vs female) gender	**0.59 (-0.06 ; 1.24)**	**0.075**		
Control group				
Age (years)	**0.08 (0.06; 0.09)**	**< 0.0001**	**0.06 (0.05; 0.08)**	**< 0.0001**
IMC (kg/m²)	0.07 (0.03; 0.12)	0.003	0.02 (-0.01; 0.05)	0.139
Mean BP (mmHg)	**0.06 (0.03; 0.09)**	**0.001**	**0.04 (0.02; 0.06)**	**0.0002**
Male (vs female) gender	0.42 (-0.16; 1.00)	0.152		

DISCUSSION

In this study, we found that the mean 24-hour, daytime and nighttime POVs were slightly higher in COVID-19 patients than in controls, but this COVID-19 infection was not significantly associated with increased POV (P=0.082).

General characteristics of the study population

Males were the most represented (56%) with a sex ratio M/F= 1.26. This result is higher than that of Joy et al who reported 42% of male patients [12]. This could be explained by the fact that the majority of PAD employees are men. The average age of the patients in our study was 41± 11 years. This result is close to that of Joy et al who found an average age of 37± 5.3 years [12]. This confirms the essentially young nature of the African population. Ngatchou et al reported young age as a protective factor for the risk of mortality from COVID-19 [13]. CRP was significantly higher in COVID-19 patients than in controls (p=0.001). This may be explained by the systemic inflammation induced by Sars-CoV-2 with the release of cytokines. Clinical POV was increased in COVID-19 patients compared to controls in our study. Ratchford et al and Snaubelt et al reported similar results [14, 15].

Variation in 24-hour OPV between cases and controls

In our study, 24-hour, daytime and nighttime OPV values were higher in COVID-19 patients than in controls. But COVID-19 status was not correlated with increased arterial stiffness (P= 0.082). Our results differ from those of Racthford et al who reported a significant increase of 0.75m/s in POV in COVID-19 patients compared to the control group [14]. This may be justified by the fact that our patients were tested directly after the Covid test results; whereas Racthford et al measured POVs 3 to 4 weeks after SARS-CoV-2 infection. The elevated arterial stiffness in the Covid 19 positive group could be attributed to a variety of pathophysiological mechanisms, including SARS-CoV-2 induced systemic hyperinflammation with cytokine release [16] and direct endothelial damage by binding of SARS-CoV-2 to endothelial angiotensin-2 converting enzyme receptors [17].

The independent determinant that could vary the pulse wave velocity was age. This is because the elastic properties of the arterial wall are physiologically affected by age. These results are consistent with those found by Rodilla et al who found that patients with advanced age were correlated with increased arterial stiffness [18]. Similarly, Mitchell et al state that with age, structural alteration of the arterial wall appears to be at the forefront of physiological alterations [19]. Indeed, advanced age is known to be an important determinant of cardiovascular risk and POV increases by 1m/s per decade before age 50, then by 2m/s after age 50 [20].

CONCLUSION

In our study, we found that POVs were slightly higher in COVID-19 patients than in controls and that in the acute phase of Sarscov-2 infection, the increase in arterial stiffness was not significantly associated with COVID-19 status. Large prospective studies will better assess the long-term impact of SARS-COV-2 infection on overall cardiovascular risk in African-born black subjects.

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