International Journal For Research In Biology & Pharmacy

GLYCEMIA AND HbA1c WITH PATIENTS INFECTED BY SARS CoV-2 IN A BIOCHEMICAL LABORATORY IN 2020

RANAIVOSOA Miora Koloina[1], RAKOTONJAFINIARIVO Faralahy Harisolofo[1], RAHARILIVASOA Fenohasina[2] ,RASAMINDRAKOTROKA Andry[3]

[1]Biologist. Laboratory of Biochemistry of Joseph Ravoahangy Andrianavalona University

Hospital Antananarivo, Madagascar

[2]Medical Biology Student, Laboratory of Joseph Ravoahangy Andrianavalona University

Hospital Antananarivo, Madagascar

[3]Professor of Immunology, Laboratory of Training and Research in Medical Biology,
University of Antananarivo, Madagascar

***Corresponding Author: Miora Koloina Ranaivosoa** , Laboratory of Biochemistry of Joseph*

Ravoahangy Andrianavalona University Hospital Antananarivo, Madagascar,

Contact of corresponding author : +261 34 58 003 28; mathyakris@yahoo.fr

Summary

Coronavirus disease 2019 is a viral zoonosis caused by the Severe Acute Respiratory Syndrome Coronavirus-2 strain of coronavirus. The aim of this study is to determine the glycaemic disturbances in patients infected with SARS CoV-2. This is a retrospective and descriptive study conducted at the Paraclinical Service of Training and Researches in Biochemistry at the University Hospital Center of Joseph Ravoahangy Andrianavalona, Antananarivo from January 1st to June 30th 2021. The data were collected from the laboratory analysis request forms. All test requests belonging to coronavirus-infected patients mentioned in the clinical information and involving a simultaneous fasting blood glucose and HbA1c test were included. Our study included 52 patients of whom 53.87% were male and 46.15% female. The average age was 58 years. The average blood glucose value was 10.78 mmol/l, that of HbA1c was 4.9%. The average blood glucose value was significantly higher with men than with women. The highest average blood glucose level (12.96 mmol/l) was found between the age group 35-45 years. The average HbA1c in the 35-45 age group was the highest but still within the normal range. Hyperglycaemia is frequently observed during SARS-CoV-2 infection in diabetics and non-diabetics by several mechanisms.

Keywords : *Antananarivo, Biochemistry, Glycemia, HbA1c, SRAS CoV-2*

Introduction

Coronavirus disease 2019, referred to by the World Health Organization (WHO) as COVID-19, is a viral zoonosis caused by the Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) strain of coronavirus [1,2].

Coronavirus 2019 (COVID-19) is an emerging infectious disease that was first reported in Wuhan, China, and subsequently spread worldwide [3].

Hyperglycaemia has been associated with in-hospital complications in SARS cov-2 infected patients with and without diabetes [4,5].

The aim of this study is to determine the glycaemic disturbances in patients infected with SARS CoV-2.

Materials and methods

This is a retrospective and descriptive study conducted at the Paraclinical Service of Training and Researches (UPFR) in Biochemistry at the University Hospital Center of Joseph Ravoahangy Andrianavalona (UHC-JRA), from January 1st to June 30th 2021. The data were collected from the laboratory analysis request forms. All test requests belonging to coronavirus-infected patients mentioned in the clinical information and involving a simultaneous fasting blood glucose and HbA1c test were included. Any test request forms that were incompletely filled out and/or without specific clinical information were excluded. Gender, age, fasting blood glucose and HbA1c results were studied.

Blood samples were taken on a grey tube with sodium fluoride and potassium oxalate for fasting blood glucose and on an EDTA (ethylene diamine tetraacetic acid) tube for HbA1c. The Mindray BS300® from Shenzhen

Mindray Bio-medical Electronics Co is used to measure blood glucose and HbA1c. For blood glucose, a colorimetric enzymatic end-point method with glucose oxidase was used. The turbidimetric method for HbA1c (Cromatest, Barcelona, Spain).

The reference values for blood glucose and HbA1c at the UPFR Biochemistry of the University Hospital (UHC-JRA) are shown in Table I.

Table I- The reference values for blood glucose and HbA1c at the UPFR Biochemistry of the University Hospital

Parameters	Reference values
Glycemia (mmol/l)	4,20-6,40
HbA1c (%)	<6,5

Hyperglycaemia is defined as blood glucose > 7.80 mmol/L (140 mg/dL) in 2 or more determinations [6].

Student's T-test was used to compare the observed results. The difference between two averages was considered significant when $p < 0.05$. The results were evaluated using Microsoft Office Excel 2007 and Epi info 7.0.

Results

Our study included 52 patients of whom 53.87% were male and 46.15% female. The average age was 58 years with extremes of 25 to 75 years.

The average blood glucose value was 10.78 mmol/l, that of HbA1c was 4.9%. The average blood glucose value was significantly higher with men than with women with a p value of 0.03. No statistically significant difference in HbA1c was observed between the two genders. The highest average blood glucose level (12.96 mmol/l) was found between the age group 35-45 years (figure 1). The average HbA1c levels were normal in all age groups. The average HbA1c in the 35-45 age group was the highest but still within the normal range (figure 2)
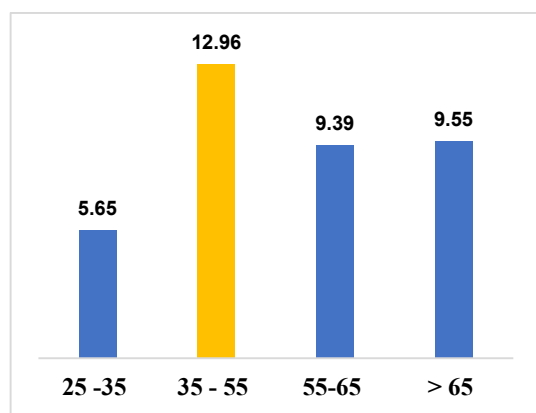

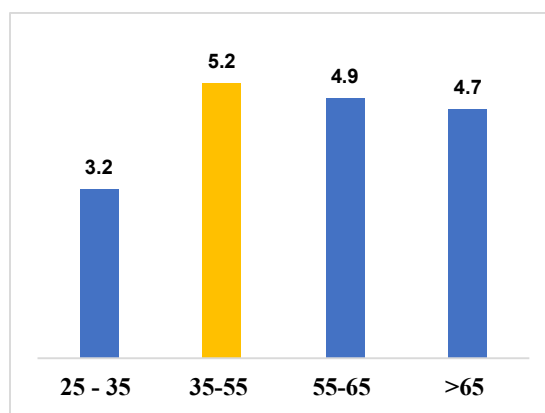Figure 1- Variation of average blood glucose level by age

Figure 2- Variation in average HbA1c by age

Discussion

This male predominance has been found in several studies with varying proportions: Omer Ayten et al (64.40%) [7], Huang et al (73.0%) [8], Wang et al (54.3%) [9], Zhang et al (50.7%) [10]. This male predominance was confirmed by a study reporting that circulating CEA2 levels are higher with men than with women [11]. SARAS-CoV-2 uses angiotensin converting enzyme 2 as a functional coronavirus receptor to enter the host cell [12,13]. Furthermore, the X chromosome contains a high density of immune-related genes; therefore, women generally develop stronger innate and adaptive immune responses than men [11,14]. The average age in our study was 58 years. The average ages found in some studies were almost similar to ours: Omer Ayten et al (56.9 years) [6], Chen N et al (55.5 years) [15] and Bouzid G et al (60.0 years) [16]. Another study by Gao Y et al. reported a lower average age in their study at 44 years [17].

The average blood glucose level in our study was 10.78 mmol/l. Of our 52 patients, 43.90% had hyperglycaemia whose diabetes status could not be investigated. In the study by Wen Zhang et al, the average blood glucose level in diabetics was 9.91 mmol/l and 5.54 mmol/l in non-diabetics. Of these diabetic patients, 71.58% suffered from hyperglycaemia and 13.03% in non-diabetics [18]. Several hypotheses have been put forward to explain this hyperglycaemia during SARS-CoV-2 infection: firstly, pancreatic beta cells may be highly permissive to SARS-CoV-2 infection [19] as ACE2 is also expressed on pancreatic islet cells. Thus, the possibility of acute pancreatic β-cell injury via angiotensin 2 converting enzyme. Secondly, glucocorticoids could also cause hyperglycaemia by inducing insulin resistance and beta cell dysfunction [20]. Thirdly, the massive release of cytokines and glucocorticoids during overwhelming viral infection [21] induced the stimulation of gluconeogenesis and an increase in insulin resistance [22, 23], which could also contribute to this rise in blood glucose.

In our study, patients had a high average blood glucose level while the average HbA1c was normal. This result may indicate that patients are predisposed to fluctuating blood glucose levels when exposed to a virus [18].

The parallel increase in HbA1c and blood glucose in the 35-55 age group (figure 1 and 2) could be explained by the fact that HbA1c is influenced by blood glucose levels in the last 4 months, but blood glucose levels in the previous 30 days are responsible for 50% of its value. [24].

Conclusion

Hyperglycaemia is frequently observed during SARS-CoV-2 infection in diabetics and non-diabetics by several mechanisms. Glycaemic disturbances have been found more frequently with men than with women.

References

1.World Health Organization; (2020). WHO Director-General's remarks at the media briefing on 2019-nCoV on (11 February 2020). Available from: https://www.who.int/dg/speeches/detail/who-director-general-s-remarks-at-the-media-briefing-on-2019-ncov-on-11-february-2020.11.

2.MOUEDEN AM, BENLALDJ D, MESSAOUDI R, SEGHIER F. Profil hématologique des patients atteints de COVID-19 au niveau du CHU d'Oran en Algérie. ALGERIAN JOURNAL OF HEALTH SCIENCES 2021 ;3(2) :22-9.

3.Chaomin W, Xiaoyan C, Yanping C, Jia'an X, Xing Z et al.Risk Factors Associated With Acute Respiratory Distress Syndrome and Death in Patients With Coronavirus Disease 2019 Pneumonia in Wuhan, China. JAMA Intern Med 2020 ; 180(7):934-43.

4.Carrasco-Sánchez FJ, Carretero-Gómez J, Gómez-Huelgas R, Garcia-Ordoñez MA, Pardo-

Ortega MV et al. Stress-induced hyperglycemia on complications in non-critically elderly hospitalized patients. Rev Clin Esp 2018 ; 218:223–31. https://doi.org/10.1016/j.rce.2018.02.017.

5. Carrasco-Sánchez FJ, López-Carmona MD, Martínez-Marcos FJ, Pérez-Belmonte L M.,Hidalgo-Jiménez A et al. *Admission hyperglycemia as a predictor of mortality in patients hospitalized with COVID-19 regardless of diabetes status: Data from the Spanish SEMI-COVID-19 Registry. Annals of Medicine 2020. DOI:10.1080/07853890.2020.1836566*

6. American Diabetes Association, "Diabetes care in the hospital: standards of medical care in diabetes-2020,Diabetes Care 2020, 43(1) :193–202.

7. Omer A, Bengu S. Analyse rétrospéctive des patients atteints de pneumonie COVID-19 sévère traités par lopinavir/ritonavir : une comparaison avec des patients survivants et non survivants. Southern African Journal of Infectious Diseases 2020 ;35(1). A233.https://doi.org/10.4102/sajid.v35i1.233

8. Huang C, WangY, Li X, Ren L, Zhao J et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China, Lancet 2020 ;395(10223) :497-506.

9.Wang D, Hu B, Hu C, Zhu F, Liu X et al. Clinical Characteristics of 138 Hospitalized Patients With 2019 Novel Coronavirus-Infected Pneumonia in Wuhan, China. JAMA 2020 ;323(11):1061-9.

10.ZhangJJ, Dong X, Cao YY, Yuan YD, Yang YB et al. Clinical characteristics of 140 patients infected with SARS-CoV-2 in Wuhan, China. Allergy 2020 ; 75(7):1730-41.

11.Derek M, Griffith, PhD, Garima S, MD et al. Men and COVID19: A biopsychosocial approach to understanding sex differences in mortality and recommandations for practice and policy interventios. Prev chronic dis2020 ; 17(E63)

12.Sama IE, Ravera A, Santema et al. Concentration plasmatique circulante de l'enzyme de conversion de l'angiotensine 2 chez les hommes et les femmes souffrant d'insuffisance cardiaque et effets des inhibiteurs de la rénine-angiotensine-aldostérone. Eur Heart J 2020; 41(19):1810-7

13. Li W, Moore MJ, Vasilieva N, Sui J, Wong SK et al. Angiotensin-converting enzyme 2 is a functional receptor for the SARS coronavirus. Nature 2003;426(6965):450–4.

14. Sharma G, Volgman AS, Michos ED. Sex differences in mortality from COVID-19 pandemic: are men vulnerable and women protected? JACC Case Rep 2020.

15.Chen N, Zhou M, Xuang D, Qu J Fengyun G et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. Lancet 2020;395:507-13.

16. Bouzid G et al. Rôle du système ABO et étude des facteurs prédictifs de mortalité dans l'infection à SARS-COV-2. MedrXiv 2020.

17. Gao Y, Li T, Han M,Xiuyong Li, Dong Wu et al. Diagnostic utility of clinical laboratory data determinations for patients with severe COVID19. Med Virol 2020 ; 92(7) :791-6. doi:

10.1002/jmv.25770

18. Wen Zhang, Chuanwei Li,Yu Xu, Binfeng He, Mingdong Hu,Guoqiang Cao et al. Hyperglycemia and Correlated High Levels of Inflammation Have a Positive Relationship with the Severity of Coronavirus Disease 2019. Mediators of Inflammation 2021 :881204 https://doi.org/10.1155/2021/8812304.

19.Yang L, Han Y,Nilsson-Payant BE, Gupta V, Wang P, et al. A Human Pluripotent Stem Cell-based Platform to Study SARS-CoV-2 Tropism and Model Virus Infection in Human Cells and Organoids. Cell Stem Cell. 2020 Jul 2 ;27(1):125-36.

20.ReiteM, RajanM,Gómez-BanoyN, LauJD, Gomez-EscobarLG, Alvarez-MulettAG et al. Hyperglycemia in Acute COVID-19 is Characterized by Adipose Tissue Dysfunction and Insulin Resistance.2021. doi: https://doi.org/10.1101/2021.03.21.21254072

21. Lu R., Zhao X., Li J ,Niu P, Yang B, et al. Genomic characterisation and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. Lancet. 2020;395(10224):565-74. doi: 10.1016/S0140-6736(20)30251-8.

22. Yang JK., Feng Y, Yuan MY, FuHJ,WuetBY al. Plasma glucose levels and diabetes are independent predictors for mortality and morbidity in patients with SARS. Diabetic Medicine. 2006;23(6):623-28. doi: 10.1111/j.1464-5491.2006.01861.x

23. Umpierrez G. E., Isaacs S. D., Bazargan N., You X., Thaler L. M., Kitabchi A. E. Hyperglycemia: an independent marker of in-hospital mortality in patients with undiagnosed diabetes. The Journal of Clinical Endocrinology and Metabolism2002 ;87(3):978-82. doi: 10.1210/jcem.87.3.8341 ;

24-Wojtusciszyn.A. Montpellier HbA1c trap. General review.