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Haemato-Biochemical Profile of COVID-19 Patients Hospitalized At the The Amissa Bongo Regional Hospital Center (ABRHC) in Franceville, Gabon

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ABSTRACT

Taking place from 16 May to 31 August 2021, the aim of this study was to describe the haemato-biochemical profile of COVID-19 patients in 250 diagnosed individuals. With a sex ratio of 0.84, seventy-nine symptomatic COVID-19 patients, 36 of whom (45.57%) were less infected and 43 of whom (54.43%) were predominantly infected, were hospitalised at the SICOV of the CHRAB. They ranged in age from twenty-one to eighty-one years, with an average age of 45±5 years. After taking blood samples and collecting certain biological specimens for the determination of plasma electrolytes (sodium, potassium, chlorine and calcium), the analysis of the results and the estimation of the values of the haematological parameters of the interned patients revealed that one patient suffered from a hypochromic microcytic anaemia associated with thrombocytopenia. Hyperleukocytosis was found in 43% of cases, 43% of subjects had lymphopenia, 39.2% of cases had thrombocytopenia, and 63.3% had anemia. Observation of biochemical parameters revealed a uraemia rate of less than 35.89% for all 79 patients. 31.7% of patients had elevated creatinemia. 58.34% had elevated AST and ALT levels, 5% had elevated total bilirubin. Sodium (Na+=77%), potassium (K+=33%) and calcium (Ca2+=20%) levels were significantly lower, forcing the patients to develop a severe form of COVID- 19. Hypochloremia was present in 20% of these patients. While 20% hypercalcaemia was recorded in the patients, there were no cases of hypocalcaemia. Some patients suffered from co-morbidities such

as renal failure and heart failure. Of the 79 patients hospitalised, 11 died (13.92%) and 68 were cured (86.08%). The risk of death was higher in patients with one or more co-morbidities. Our study shows that in patients under 58 years of age, 27.3% of the deceased patients had at least one reported co-morbidity such as diabetes (3.79%) and/or hypertension (6.28%).

Key words: COVID-19, SARS-CoV-2, Hematobiochemical

INTRODUCTION

Having been predicted by the United Nations Commission for Africa (UNCAF) and the World Health Organization (WHO) to be subject to the greatest health catastrophe in its history when the coronavirus pandemic arrives on its soil, the African continent has been spared due to several parameters that are scientifically unknown until now and that could reduce the severity of this pandemic. According to the African Centre for Disease Control and Prevention, Africa had accumulated 4.437,846 cases and a total of 118,133 deaths by 20 April 2021 alone [1]. According to COVID pandemic data as of 1 November 2020 by country and territory, Gabon has recorded: 8,968 confirmed cases, 215 active cases, 8,698 recoveries, and 55 deaths [2|. These results are due to the fact that as soon as this coronavirus disease arrived on Gabonese soil in March 2020, the government took public health and social measures such as: closing land, sea and air borders, setting up quarantine centres for cases, respecting barrier measures and self-isolation of exposed persons. In concrete terms, the Integrated Disease Surveillance (IDS) framework was used for surveillance and case detection [3]. As biochemical and haematological reference values are essential to assess disease and monitor the effects of treatment in health care practice and clinical trials [4], the extraordinary high cure rate recorded at national level (90.9%) [5], prompted us to study the behaviour of blood cells, kidney and liver functions and plasma electrolytes in symptomatic COVID-19 patients, especially as no studies had been done on this subject in Haut Ogooué province. Out of 250 patients diagnosed by RT-PCR, this study focused on 79 symptomatic COVID-19 patients admitted and hospitalised at the COVID-19 patient management site (SICOV) located within the Centre Hospitalier Régional Amissa Bongo (CHRAB) in Franceville. A detailed history was taken of all patients and the clinical examination involved haematological and biochemical investigations as well as repeated RT-PCR tests on nasopharyngeal and oropharyngeal swab samples. Cure of the COVID-19 patient was confirmed when the RT-PCR test was declared negative.

MATERIALS AND METHODS

Location of the study

This study was conducted between the medical analysis laboratory and the medicine department of the Centre Hospitalier Régional Amissa Bongo in Franceville, the second largest province in Gabon, where a site for the management of COVID-19 patients was set up and named "SICOV" for the isolation of Covid-19 patients.

Type and period of study

This is a retrospective observational and descriptive study of data obtained from the results of medical analyses of blood samples of 79 symptomatic COVID-19 patients hospitalised at the Amissa Bongo Regional Hospital of Franceville (CHRAB), named SICOV between 16 May and 31 August 2021. The diagnosis of the virus was carried out by gene amplification on the Applied Biosystems AB 7500 Real Time PCR System according to a diagnostic protocol for SARS-CoV-2

validated by Africa CDC and the African Union. Patient demographics as recorded by the nursing staff on the patient's chart, medical history: diabetes, hypertension, tuberculosis, malaria, renal failure, smoking, alcoholism, anaemia, hypercholesterolaemia, asthenia, coronary artery disease and obesity were recorded. Obstetrical history such as pregnancy, caesarean delivery and the circumstances of discovery of the disease were recorded. Functional symptomatology, vital signs, and laboratory and radiological findings on admission were also recorded.

Inclusion and exclusion criteria

COVID-19 patients admitted to SICOV during the study period from 16 May to 31 August 2020 were included in the study. Any COVID-19 patient not admitted to the SICOV during the study period was excluded, as well as all non-operational records.

Sampling

Blood samples taken in dry tubes, fluoride oxalate tubes and EDTA tubes from SICOV and provided with their examination vouchers were collected at any time of the day or night in the medical analysis laboratory of CHRAB. For the determination of plasma electrolytes (sodium, potassium, chlorine and calcium). Biological specimens were collected in lithium heparin tubes.

Analytical procedure

The pre-analytical phase consisted of ensuring the conformity of the sample (correct identification, sufficient quantity of blood, appropriate container, absence of blood clots), then recording the patient's data in the central activity register (name, first names, age, sex, examinations requested). A fractionation of the blood collected in the fluoride oxalate tubes and dry tubes, was then centrifuged "Hettich Zentrifugen Rotina 35 Type 1705" set at 4500 rpm for 5 minutes. The analytical phase consisted of carrying out the various examinations recorded on the examination form. Thus, with the whole blood collected on EDTA tubes, a haemogram was carried out on the "Mindray BC 3000Plus" haematology machine. The determination of biochemical parameters (blood glucose, urea, creatinine, transaminases, total bilirubin) was carried out using the "ABX Pentra 400" biochemistry analyser with the plasma collected in the fluoride oxalate tube and the serum in the dry tube. Finally, the post-analytical phase consisted of checking and recording all the analytical results obtained in the registers of the disciplines concerned, and then transcribing them on "Microsoft Word Office 2007" software.

Approval of the study

The study was approved by the General Management of CHRAB. The law on the protection of privacy was respected according to the code of ethics in the Gabonese Republic and the publication of this manuscript was authorised by the General Management of CHRAB.

Statistical studies

The descriptive statistical studies are presented as mean and standard deviation for continuous variables and as frequencies for categorical variables.

RESULTS

Socio-demographic characteristics

Distribution of SARS-CoV-2 carriage according to gender and age groups

For this study, only 79 patients or 36.1% were selected out of 250 patients diagnosed by RT-PCR. With (54.43%, n=43), women were in the majority compared to men (45.57, n=36). The

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extremes of age ranged from 20 to 80 years, with an average age of 45 ± 5 years. The majority of patients affected by SARS CoV-2 (17.72%, n=14) were represented by the age group 46-51 years, followed by 64-69 years. (Table 1).

Table 1: Distribution of SARS-CoV-2 carriage by gender and age groups

Age groups	Men	Women	Total
Less than 20 years old	0	1	1
21 -26 years	3	5	8
27-32 years	5	3	8
33-38 years	1	4	5
39-45 years	5	3	8
46 – 51 years	**8**	**6**	**14**
52 – 57 years	4	4	8
58 – 63 years	3	4	7
64 -69 years	**5**	**8**	**13**
70 – 75 years	1	2	3
76 – 80 years	1	3	4
Total	**36**	**43**	**79**

Table 2 below shows that fever, with 12% n = 23 cases, was the first symptom that led to a consultation, followed by cough (9.95% n = 19) and dyspnea (8.9% n = 17)

Table 2: Frequency distribution of symptoms related to COVID-19

	Numberf (n)	Percentage (%)
Asthenia	14	7.33
Choking	4	2,1
Coughing	**19**	**9.95**
Respiratory distress	6	3,14
Dyspnea	**17**	**8.9**
Fever	**23**	**12.0**
Diarrhoea	3	1.57
Tired	1	0.52
Coma	2	1.04
Contact subject	4	2.1
Mycosis	1	0.52
Loss of taste	2	1.04
Loss of sense of smell	2	1.04
Hernia operation	1	0.52
Tachycardia	1	0.52
Pregnancy	1	0.52
Vertigo	3	1.57
No data	16	8.37

Palpitation	1	0,52
Altered consciousness	3	1.57
Shivering	2	1.04
Epigastralgia	10	5.23
Chest pain	12	6.28
Caesarean section	2	1.04
Polypnea	1	0.52
Headache	12	6.28
Anorexia	4	2.1
Polyaltragia	2	1,04
Vomiting	1	0.52
Anthrax	1	0.52
Joint pain	1	0.52
Diabetes	7	3.79
HTA	12	6.28
TOTAL	**191**	**100**

Haematological and biochemical parameters

The estimation of the haematological parameters output by the Mindray 3000 Plus machine presented in Table 3 shows their minimum values, maximum values, and the geometric mean in relation to the normal values of the blood cells found in all 79 COVID-19 patients. Low levels of red blood cells, CVD haemoglobin and even platelets are noted.

Table 3: Estimated values for haematological parameters

Parameters	Numbers	Minimum	Maximum	Geometric mean	Normal Values
WBC /µl	79	2,5	47,6	8,44	4,0 – 9,0 K/µl
Lymphocytes %	79	5,5	77,2	25,25	20 – 40 %
Monocytes %	79	0,7	14,9	8,48	3 – 10 %
Granulocytes %	79	22,1	93	65,12	50 – 70 %
RBC / µl	79	1,32	5,96	**3,93**	4,5 – 5,9 M/µl
Hemoglobin g/dl	79	3,1	17,5	**9,88**	12 – 16 g/dl
HCT %	79	9,2	47	**29,78**	37 – 57 %
MCV fl	79	11,4	95	**23,4**	80 - 100 fl
MCH pg	79	20,1	36,2	**12,51**	27 – 32 pg
MCHC g/dl	79	25,7	40,2	33,8	32 – 36 g/dl
Patelets / µl	79	36	517	**97,8**	150 – 450 K/µl

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Distribution of haematological parameters according to normal values

Table 4 shows the distribution of haematological parameters below, within and above the normal values obtained by different numbers of the study population. It can be seen that 34 patients had a blood cell count (WBC) above normal, 34 patients had a lymphocyte count below normal, the red blood cell count was below normal in 35% of patients, the red blood cell count 63.3%, was below normal in 28 patients with an average haemoglobin in the volume occupied by red blood cells. (MCV) was also lower in 62 patients. A lower than normal platelet count was also noted in 31 patients.

Table 4: Distribution of haematological parameters obtained with the Mindray 3000 Plus in relation to normal values

	Numbers	**Below normal values**		**Within normal values**		**Above normal values**	
Valeurs des patients	79	n	%	n	%	n	%
GB	79	9	11,4	36	45,6	**34**	**43**
Lymphocytes	79	**34**	**43**	32	40,5	13	16,5
Monocytes	79	4	5,1	58	73,4	**17**	**21,5**
Granulocytes	79	15	19	26	33	**38**	**48**
Globules Rouges	79	**28**	**35,4**	48	60,8	3	3,8
Hémoglobine	79	**50**	**63,3**	29	36,7	0	0
Hématocrite	79	27	34,2	**42**	**53,2**	10	12,6
MCV	79	**62**	**78,5**	17	21,5	0	0
MCH	79	**56**	**70,8**	21	26,6	2	2,6
MCHC	79	7	8,8	**47**	**59,5**	25	31,7
Plaquettes	79	31	**39,2**	**45**	**57**	3	3,8

Biochemical parameters

The biochemical parameters of some of the 79 COVID-19 patients in this study were measured using the ABX Pentra 400. Table 5 shows the distribution of the different values, i.e. below, within or above the normal values of the different markers of renal function, liver function and the distribution of plasma electrolytes obtained by different numbers of the study population.

Table 5: Biochemical parameter profiles

Parameters	Numbers	Below normal values	Within normal values	Above normal values	Normal values
Renal function					
Urea	39	1 (2,57%)	24 (61,54%)	14 (35,89%)	1,7 – 8,3 mmol/l
Créatinine	41	0 (0%)	28 (68,3%)	13 (31,70%)	15 – 115 µmol/l
Liver function					
ASAT	12	0 (0%)	5 (41,64%)	7 (58,34%)	1 – 35 UI/L
ALAT	12	0 (0%)	5 (41,64%)	7 (58,34%)	1 – 42 UI/L
Total bilirubin	8	0 (0%)	7 (87,5%)	1 (12,5%)	< 17,1 µmol/L
Electrolytes plasmatiques					
Sodium (Na+)	5	2 (40%)	3 (60%)	0 (0%)	135 – 148 mmol/L
Potassium (K+)	5	1 (20%)	2 (40%)	2 (40%)	3,50 – 5,30 mmol/L
Chlore (Cl^-)	5	1 (20%)	3 (60%)	1 (20%)	98 – 107 mmol/L
Calcium (Ca^2+)	10	0 (0%)	8 (80%)	2 (20%)	2,10 – 2,70 mmol/L

Prevalence of mortality rate of SICOV patients

Of the 79 patients at SICOV (n = 11) died (13.92%) and 68 were cured (86.08%) (Table 6).

Table 6: Prevalence of patient mortality at SICOV

Mortality rate	SARS-CoV-2	Other diseases
Died	11	13,92
Recovered	68	86,08
TOTAL	79	100

DISCUSSION

The objective of this study was to observe the haemato-biochemical profile of patients infected with the SARS-CoV-2 virus and hospitalised at the Centre Hospitalier Régional Amissa Bongo (CHRAB) of Franceville. The diagnostic methods were the haemogram, which was designed to count blood elements, and the biochemical determination by spectrophotometry of urea, creatinine, transaminases (ASAT/ALAT), bilirubin, and plasma electrolytes. Taking into account the socio-demographic characteristics of SARS-CoV-2 patients according to gender and age groups of patients', our study shows that the age group of 45-50 years represented the most affected patients by SARS-CoV-2, followed by the age group of 63 and 68 years. These were 17.72% and 12.66% respectively (Table 1). These results are quite similar to those found in 2020 by Ketfi et al where they reported that the average age of their patients was 53 years and 54.6% of the patients were older than 50 years [6]. These data are intermediate with those reported in the study by Guan et al, conducted in 2020, where the median age ranged from 44

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to 57 years [7|. This is justified by a more active age range in contemporary societies. Contrary to other studies such as the one conducted by the Belgian Institute of Health (sciensano) in 2020, and the one reported by Zhou F et al in 2020, which indicated that among hospitalized patients, there was a majority of males than females or the one reported by [8,9|, our study population was predominantly represented by female patients (54.43%), more carriers of COVID-19 than male patients (45.57%), i.e. a sex ratio of 0.84 (Table 1). These differences in numbers could be explained by the fact that SARS-CoV-2 infection did not discriminate by sex. With 12% of cases, fever was the first symptom among all reasons for consultation, followed by cough (9.95%) and dyspnoea (8.9%) (Table 2). These results are very similar to those found by the Belgian Institute of Health "sciensano" who show in their work that the most present symptoms at admission were fever (61%), cough (52%), shortness of breath (49%), and generalized weakness (39%) [8|. In contrast, in the study by Ketfi et al. 2020, asthenia was the most frequently reported sign (80.2%), and dyspnoea (29.1%) was ranked tenth [6|.

Haematological analyses

Estimation of haematological parameters in symptomatic COVID-19 patients admitted to SICOV (Table 3) revealed one patient with paler than usual red blood cells (erythrocytes). Thus, this patient had a hypochromic microcytic anaemia. This could be due to the fact that she was menstruating when she was infected and hospitalised at SICOV. Compared to normal, an elevated white blood cell count signifying hyperleukocytosis was found in 43% of patients (Table 3). These results are superior to those found by (Rodriguez-Morales et al. 2020; Wang et al., 2020) who found hyperleukocytosis in 8-30% of cases. The hyperleukocytosis found was probably secondary to erythroblastosis because in acute haemolysis, the high marrow regeneration is responsible for erythroblastosis causing a false hyperleukocytosis, or this hyperleukocytosis is related to an infectious risk present in the environment. [10,11|.

In other studies, the same authors have found lymphopenia in about 50% of hospitalised patients with COVID-19 [10,11]. These results are quite similar to those found in our study where we found a rate of 43% of subjects with lymphopenia (Table 4). This may be explained by the fact that the patients were under drug treatment (corticosteroids, chemotherapy, immunosuppressive treatments) causing an excess of lymphocyte catabolism. A Chinese study of 1099 patients from 31 directly controlled provinces/municipalities showed that 36.2% of these patients had thrombocytopenia [7], whereas our study found 39.2% of cases with low platelet counts characteristic of thrombocytopenia (Table 4). These results are quite similar, but are much lower than those found by Chang et al, where in 13 patients from 3 hospitals in Beijing, 72.5% developed thrombocytopenia [12]. This may simply be explained by the infection of the patients with SARS-CoV-2 virus or by the multiple medications that would cause skin bleeding and bruising observed in these patients during the first days of their hospitalisation. In one study, the haematological changes of thrombocytopenia in patients with COVID-19 were summarised and possible mechanisms by which COVID-19 causes thrombocytopenia are proposed [13|. Of the 79 patients 63.3%, (n =50) had anaemia (Table 4). The data in this table indicate that anaemia was prevalent in patients with severe SARS-CoV-2 infection and that this erythrocytopathy associated with longer hospital stays under poor clinical conditions resulted in a very low expectation of patient survival. To this end, blood unit transfusions have been in high demand to compensate for the low haemoglobin levels in these patients. In the study by Bellmann-Weiler et al, out of 259 patients hospitalised with COVID-19, (24.7%) had anaemia on admission [14]. Of 79 patients in our study, only 64 had some form of

anaemia which was mild in 38 patients (14.7%), moderate in 21 patients (8.1%) and severe in 5 subjects (1.9%). Like Zhou et al,2020, we indicate that anaemic patients had a higher prevalence of co-morbidities such as arterial hypertension, cardiovascular disease or chronic kidney disease, all of which play an unfavourable role in patients being known risk factors for death associated with COVID-19 [9|.

Biochemical analysis

A Chinese study by Cheng et al. reported that among 710 patients hospitalised with COVID-19, uraemia was 14.1% [15|. This rate is lower than 35.89% for the 79 hospitalised patients in our study (Table 5). According to typical and observational studies, an increase in blood creatinine kinase (CK) was observed in 10.8% and 21.3% of hospitalized patients with COVID-19 [16,10]. Patients with a severe form of the disease reportedly have higher levels of CK (≥ 200 U/l) compared to those with a non-severe form [7]. In our study, 31.7% of patients had elevated creatinine levels (Table 5). These results are higher than theirs, possibly due to the fact that in COVID-19 patients, acute renal failure (ARF) is multifaceted and has as many causes as ARF seen in other usual clinical situations. The chronic kidney disease inpatients in our study with COVID-19 were a particularly vulnerable population because of co-morbidities related to diseases such as cardiovascular disease and diabetes that were very present in some of our deceased patients.

In observational studies in China, ALT elevation was observed in 14.2-24.1% and AST elevation in 18.6-33.3% of hospitalized patients with COVID-19 [16,10]. ALT/ASAT elevation in about 25% (21.7-31%) has also been reported in some studies [7]. A higher AST level was also found in 62% of patients admitted to intensive care compared to 25% of patients on general admission [17]. These results are quite similar to ours as 58.34% of the study population was found to have elevated AST and ALT levels (Table 5). This increase in serum aminotransferases is certainly due to the fact that these patients were all symptomatic with COVID-19 and therefore consumed a lot of drugs, most often hepatotoxic, and this high level of transaminases can also be explained by the presence of co-morbidities such as diabetes and obesity encountered in the patients of our study. An increase in total bilirubin has been observed in 3-18% of hospitalised cases in studies conducted in China [18,7]. These results are consistent with those obtained in our study, as 12.5% of patients hospitalised at SICOV had elevated total bilirubin (Table 5). Acute hepatitis is often observed in the case of infestation with viruses such as hepatitis A, hepatitis B, hepatitis C, hepatitis D and why not with SARS-CoV-2. In cases of acute viral hepatitis, the elevation and then the decrease of transaminases precedes that of bilirubin. Of these 79 patients, 50 or 63.3% had anaemia (Table 4). Physiologically, bilirubin is produced by the degradation of haemoglobin during the destruction of red blood cells. This could probably explain the increased bilirubin level observed in the latter. Finally, liver function abnormalities may also be more frequent in hospitalized patients with COVID-19 and pneumonia than in pneumonia of another etiology [19]. According to observational studies in China with a total of 1415 patients, electrolyte imbalance was reported in hospitalized patients with COVID-19 [20]. Sodium (Na+=77%), potassium (K+ =33%) and calcium (Ca2+= 0%) levels were significantly lower in patients with COVID-19 who developed severe disease. This pooled analysis shows that the severity of COVID-19 in some of our patients was associated with a decrease in sodium, potassium and calcium concentration. The electrolyte profile of the patients was distributed as follows: 40% had hyponatremia which would result from excess water observed in our patients who were at risk populations. The potassium deficit in the blood

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plasma of our patients led to 40% of them having hyperkalaemia. The decrease in blood chlorine levels resulted in hypochloremia in 20% of the patients admitted to SICOV. While 20% hypercalcaemia was recorded in our patients, no cases of hypocalcaemia were found. (Table 5). However, these results should be interpreted with caution due to the methodological limitations of this work. Hypokalaemia is known to influence acute respiratory distress syndrome (ARDS) and acute cardiac injury, which are common complications of COVID-19, particularly in patients with underlying lung or heart disease. On the other hand, hyperkalaemia may occur in people taking potassium supplements, or taking antihypertensive or anti-inflammatory drugs such as those included in the present study, suffering from renal failure and thus justifying these results. The hyperchloremia recorded in 20% of these patients can be explained by the high heat recorded in the Haut Ogooué province and the poor functioning of the air conditioners in the CHRAB's hospital wards, resulting in excessive dehydration through sweating. Some of them suffered from co-morbidities such as renal insufficiency and heart failure. This physiological state can lead to sodium retention in the body, contributing to the development of hyponatremia in 40% of the patients. This hyponatremia can also be caused by the use of certain pharmacological substances by elderly patients, such as thiazide diuretics, which particularly increase sodium excretion, thus increasing water excretion. Finally, the prolonged immobilisation of the subjects in their hospital bed may be a response to the hypercalcaemia encountered in 20% of them. We found a higher mortality rate in men (54.7%, n = 6) in the age group 46 and 51 years. While the mortality rate for women is high (18.3% n = 2) in the age range of 70 to 75 years (Table 6). These results are quite similar to those of some studies that have shown that 90% of hospital patients who died were over 64 years of age and the risk was higher in men than in women [6]. This immune advantage for women can be explained by the fact that, according to figures from Santé Publique France, the difference is clear and persists even after the disease because women retain their protective antibodies longer, according to the results of a study by the Strasbourg University Hospital and the Pasteur Institute on 308 carers. One hypothesis put forward by the Strasbourg University Hospital concerning immunity is that the X chromosome carries this immune gene, and women have two. Moreover, oestrogen promotes immunity, unlike testosterone. More fundamentally, there is also the role of androgens, the male sex hormones, which act on an enzyme that facilitates the entry of the virus into the cells. Finally, the immune response is better in women than in men. The behaviour of men is also sufficient to explain why they develop more serious forms of the disease. They smoke more than women and are more obese. Weak lungs and overweight are important risk factors for severe forms of Covid 19 [21]. Like many other studies, we show the very high risk of death in patients with one or more co-morbidities with many disturbances in haematological and biochemical parameters

CONCLUSION

From this study, it is clear that COVID-19 alters the functioning of many biological organ functions in the patient. Although there were cases of death, most patients were cured after 10 days of hospitalisation and the average length of hospitalisation ranged from 11 to 27 days. Estimation of haematological parameter values in symptomatic COVID-19 patients revealed one patient with hypochromic microcytic anaemia associated with thrombocytopenia. Lymphopenia is often very present in these patients. Because of co-morbidities related to COVID-19, such as cardiovascular disease and diabetes, the patients represent a particularly vulnerable population. The consumption of large quantities of therapeutic pharmacological products, often hepatotoxic, leads to an increase in serum amino transferases. The anaemias

resulting from haemoglobin degradation encountered in COVID-19 patients increase their plasma bilirubin levels. In addition, their electrolyte profile was often unbalanced.

Informed consent and confidentiality of data

The authors declare that they have obtained written informed consent from the patients and/or subjects referred to in this article and also declare that the article contains no personal data that could identify the patient or subject.

References

1.- « Bulletin d'information nº 66 : sur la pandémie de la maladie à Coronavirus (COVID-19) » [archive], sur CACM, 20 avril 2021 (consulté le 21 avril 2021), p. 1)

2- Coronavirus update (live) » [archive], 3 mai 2020

3- Réponse de l'Afrique au COVID-19 », *BMC Med*, vol. 151, nº 18, 22 mai 2020 DOI 10.1186/s12916-020-01622-w,

4 - David K. Dosoo,* Kwaku P. Asante, Kingsley Kayan, Dennis Adu-Gyasi, Kingsley Osei-Kwakye, Emmanuel Mahama, Samuel Danso, Stephen Amenga-Etego, Philip Bilson, Kwadwo A. Koram, and Seth Owusu-Agyei, Biochemical and Hematologic Parameters for Children in the Middle Belt of Ghana

5- COPIL 2020 (Comité de Pilotage de la riposte national contre le COVID-19)

6 - Ketfi A., Chabati O., Chemali S., Mahjoub M., Gharnaout M., Touahri R., Djenouhat K., Selatni F. et Ben-Saad H., 2020. Profil clinique, biologique et radiologique des patients Algériens hospitalisés pour COVID-19 Pan African Medical Journal

7- Guan W., Ni Z., Yu Hu., Liang W., Ou C. and He J., 2020. Clinical Characteristics of Coronavirus Disease 2019 in China. N Engl J. Med.

8- *COVID*-19 – BULLETIN EPIDEMIOLOGIQUE. DU 30 MAI 2020. *L'institut belge de santé Sciensano*, dans le cadre de ses missions de surveillance, analyse les données ... Cas rapportés à *Sciensano* au *29 mai 2020, à 16* heures.

9 – Zhou F., Yu T., Du R., Fan G., Liu Y. and Liu Z., 2020. Clinical course and risk factors for mortality of adult in patients with COVID-19 in Wuhan, China: Lancet Lond Engl. 28; 395(10229):1054–62. PubMed | Google Scholar

10 - Rodriguez-Morales A., Cardona-Ospina J., Gutiérrez-Ocampo E., Villamizar-Peña R., Holguin-Rivera Y. and Escalera-Antezana P., 2020. Clinical laboratory and imaging features of COVID-19: A systematic review and meta-analysis. Travel Medicine and Infectious Disease.

11 - Wang X., Pan Z. and Cheng Z., 2020. Association between 2019-nCoV trans-mission and N95 respirator use. J Hosp Infect .doi.org/10.1016/j.jhin PubMed | Google Scholar

12- Chang D, Lin M, Wei L, Xie L, Zhu G, Dela Cruz CS, Sharma L (2020) Epidemiologic and clinical characteristics of novel coronavirus infections involving 13 patients outside Wuhan, China. JAMA. 10.1001/jama.2020.1623 [PMC free article] [PubMed]

13- Panyang Xu,[1] Qi Zhou,[2] and Jiancheng Xu[1] Mechanism of thrombocytopenia in COVID-19 patients Ann Hematol. 2020; 99(6): 1205–1208.Published online 2020 Apr 15. doi: 10.1007/s00277-020-04019-0

14- Bellmann-Weiler R., Lanser L., Barket R., Rangger L., Schapfl A., Schaber M., Fritsche G., Wöll E. and Weiss G., 2020 . Prevalence and Predictive Value of Anemia and Dysregulated Iron Homeostasis in Patients with COVID-19 Infection J. Clin. Med.

15 - Cheng Y., Luo R., Wang K., Meng Z., Wang Z. and Dong L., 2020. Kidney impairment is associated with in-hospital death of COVID-19 patients. Med Rxiv

16 - Fu L., Wang B., Yuan T., Chen X., Ao Y. and Fitzpatrick T., 2020. Clinical characteristics of coronavirus disease 2019 (COVID-19) in China: a systematic review and meta-analysis. Journal of Infection.

17 - Huang C., Wang Y., Li X., Ren L., Zhao J., Hu Y. and Zhan L., 2020. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet Volume 395, Issue 10223, Pages 497-506

URL: http://dx.doi.org/10.14738/jbemi.93.12549

18 - Chen N., Zhou M., Dong X., Qu J., Gong F. and Han Y., 2020. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. Lancet; 395 (10233): 507-513.

19 - Zhao K., Huang J., Dai D., Feng Y., Liu L. and Nie Shuke ., 2020. Acute myelitis after SARS-Cov2 infection: https://doi.org/10.1101/20035105.

20 - Lippi G., South A. and Henry B., 2020. Electrolyte Imbalances in Patients with Severe Coronavirus Disease 2019 (COVID-19). Annals of Clinical Biochemistry.

21 - La rédaction de LCI - Publié le 10 avril 2020 à 13h30, mis à jour le 10 avril 2020 à 13h40 . Pourquoi les hommes sont-ils plus touchés par le Covid-19 que les femmes?