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Profile of Biochemical Markers and Viral Load in a Population of Blood Donors Infected with Hepatitis B and Naive Antiretroviral Treatment in Abidjan

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Abstract: Hepatitis B is a viral infection of liver caused by a virus from the *Hepadnavirus* family. It's a public health problem in sub-Saharan Africa and particularly in Côte d'Ivoire where it is poorly documented. This study's contribution to biological databases was significant. It aimed to establish the biochemical and viral load (VL) profile of hepatitis B in a population of blood donors infected with hepatitis B virus (HBV) and naïve to antiretroviral treatment in Abidjan. It was a descriptive cross-sectional study of voluntary blood donors of any sex, with a positive result for HBsAg and naive of any antiretroviral therapy. Venous blood samples of 4 ml were collected for biochemical marker determinations, quantitative antigen, and PCR VL. A questionnaire was also used to collect socio-demographic data from study participants The National Ethics Committee for Life Sciences and Health in Cote d'Ivoire granted its approval for the study (N/Réf: 196-22/MSHPCMU/CNESVS-km). 53 voluntary blood donors infected with HBV (HBsAg positive) were included in the study. 81.13% of participants were men. The average age of all participants was 35 ± 9 years, and the predominant age group was 30 to 40 (35.85%). Transaminase values were normal in 98.57% of the study population for ASAT and 96.23% for ALAT. Creatinine was normal in 90.57% of volunteers. Total proteidaemia, natremia, and kalemia were below normal in respectively 86.79%, 73.58% and 20.75% of this population. Quantitative HBsAg were high in 24.53% of the population. Viral load was elevated in 9.43% of patients. There was a significant association between increased VL in log and increased uremia. There was also a significant association between the increase in the amount of HBs antigen and the number of copies of the virus. The study noted a renal and hepatic balance without particularity. The ion balance was disrupted, and about a quarter of the study population had high values of quantitative HBs antigenemia. The VL was high in about one-tenth of the volunteers.

Keywords: Hepatitis B, Biochemistry Markers, Viral Load, Quantitative Antigen

1. Introduction

The hepatitis B virus (HBV) is a DNA virus of the Hepadnavirus family that infects the liver and causes Hepatitis B [1]. After an acute phase, some hepatitis B cures spontaneously while others become chronic [2]. Indeed, if not diagnosed and treated, hepatitis B can progress to cirrhosis or even hepatocellular carcinoma [3, 4]. In the world, hepatitis B is a highly prevalent disease that affects more than 2 billion people, including approximately 400 million chronic carriers. It is often asymptomatic and causes significant mortality [1]. In sub-Saharan Africa, particularly in Côte d'Ivoire, where 8-10% of the population is chronically infected, there is a lack of biological data on HBV patients. [5-8].

To improve the biological data on HBV infection in Côte d'Ivoire, this investigation aims to identify the biochemical marker profile and viral load of hepatitis B in a group of infected voluntary blood donors who had not received any antiretroviral treatment in Abidjan. The specific aims of this study were to

1. Determine the mean values of the quantitative antigen and routine biochemical parameters (uraemia, total protidemia, creatinaemia, transaminasemia and ionogram) in the study population.
2. Measure the viral load
3. To look for associations between the different markers and HBV viral load.

2. Material and Methods

2.1. Type and Period of Study

Between March and April 2021, patients were recruited for a descriptive and analytical cross-sectional study from a prospective cohort followed at the National Blood Transfusion Centre of Abidjan (CNTS). The study population consisted of adult blood donors, with a positive HBsAg serological test, naïve to any antiviral treatment, and who have given their consent.

2.2. Ethical Considerations

The National Ethics Committee for Life Sciences and Health in Cote d'Ivoire granted its approval for the study (N/Réf: 196-22/MSHPCMU/CNESVS-km). To maintain confidentiality, we only disclosed the number of participants who were included. Biological data was collected as part of routine care activities, but patient names and information were not mentioned. Patients directly benefit from the results.

2.3. Biological Analysis

To carry out this study, blood was taken through venipuncture and collected in tubes without additives and tubes with ethylene diamine tetra acetic acid (EDTA).

Biochemical markers, including uremia, total proteidemia, creatinine and transaminasemia, were determined by standard methods on a Cobas® C 111 automatic spectrophotometer [9]. The blood ionogram composed of natremia, kalinemia and chloride, was measured by a flame photometer type SEAC fp 20. Quantification of HBsAg was performed with the HBsAg II assay using the immunoassay principle for the in vitro quantitative determination of hepatitis B surface antigen [10]. HBV viral load was determined using real-time PCR using COBAS® Taqman® 48 (ROCHE). DNA from circulating viruses was extracted with the High Pure System (HPS) Viral Nucleic Acid (Roche Molecular System, Branchburg, USA) kit. The analyzer automatically determines the HBV DNA title of the sample or witness using the AMPLILINK version 3.2 software. The title of HBV DNA is expressed in international units (IU) [11, 12].

2.4. Statistical Analysis

Microsoft Excel 2010 software was used to create tables and graphs. SPSS Statistics 17.0.1 was used for statistical analysis.

Homogeneity of variances was investigated by the BARTLET test. Only parameters with homogeneity in this test ($p < 0.05$) were selected. It was then applied to these variables, the ANOVA test (normal distributions) or the WILCOXON test (abnormal distributions). When the comparison showed a significant difference, the STUDENT t-test (case of homogeneous variances) or KRUSKAL WALLIS (case of non-homogeneous variances) was performed to identify the correlation level. The significance threshold of the tests used was set at 5% ($\alpha = 0.05$).

3. Results

3.1. Socio-Demographic Characteristics of Patients Included in the Study

53 voluntary blood donors were included in the study. They comprised 43 men (81.13%) and 10 women (18.86%). The mean age of the patients was 35 ± 9 years. The predominant age group (Figure 1) was 30-40 years (19/53; 35.85%).

3.2. Biological Marker Profile of the Study Population

Transaminase values were normal in 98.57% of the study population for AST with a mean of 16.37 ± 6.9 IU/l and 96.23% for ALT with a mean of 14.11 ± 9.91 IU/l. Creatinine levels were normal in 90.57% of volunteers, with an average of 8.3 ± 2.15 mg/l. Total protidemia and natraemia were below normal in 86.79% and 73.58% respectively, with mean values of 16.37 ± 6.9 g/l and 136.69 ± 1.78 mmol/l respectively. Kalaemia had a mean value of 4.64 ± 1.25 mmol/l, and 20.75% of the study population had below-normal values. The mean level of quantitative HBs antigen was $1.48x10^4$ ± $3.07x10^4$ IU/ml, with an elevated level in 24.53% of the population. The viral load was below 5 log IU/ml in 90.57% of patients with a mean of 3.58 $\log_{10}$ ± 1.69 IU/ml, and only 9.43% of patients had a value above 5 $\log_{10}$ IU/ml (Table 1).

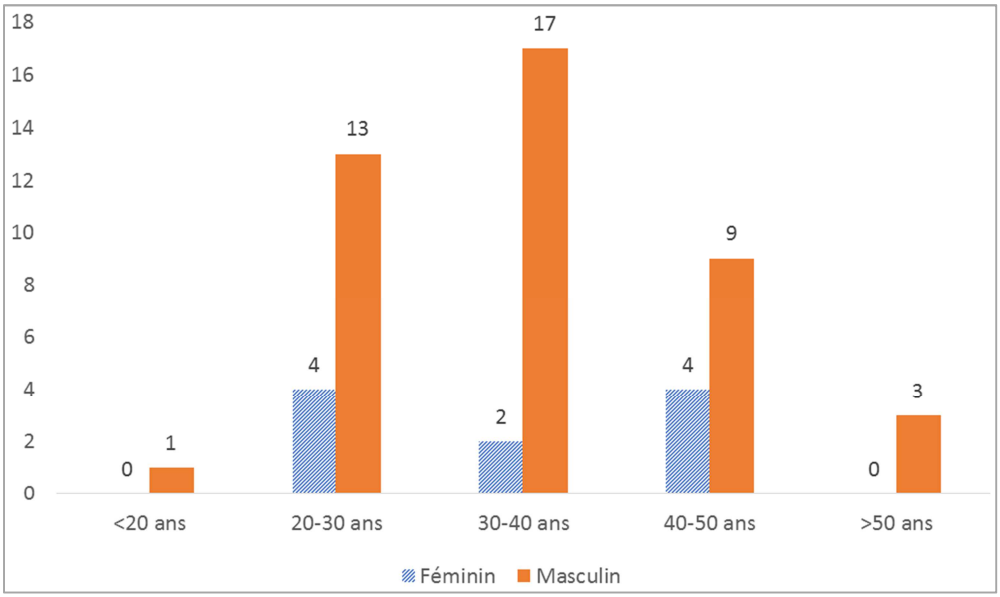

Figure 1. *Age groups of patients included in the study by gender.*

Table 1. *Biological marker profile of patients.*

Biological parameters and reference values	Results: Mean ± Standard deviation (N= 53)	Frequency of patients with normal value (%)	Frequency of patients with low value (%)	Frequency of subjects with high value (%)
Uremia [0,15 - 0,45 g/l]	0,19 ± 0,05	81,13	18,87	0
Creatininemia [6 - 14 mg/l]	8,3 ± 2,15	90,57	9,43	0
Natraemia [135 - 145 mmol/l]	136,69 ± 1,78	26,42	73,58	0
Kalaemia [3,6 - 5 mmol/l]	4,64 ± 1,25	75,47	20,75	3,77
Chloride [100 - 110 mmol/l]	102,53 ± 2,05	98,11	1,89	0
Total protidemia [65 - 80 g/l]	16,37 ± 6,9	13,21	86,79	0
AST [8 - 30 IU/l]	16,37±6,9	98,11	1,89	0
ALT [8 - 35 IU/l]	14,11±9,91	96,23	3,77	0
Quantitative HBsAg [0,005 – 13000 IU/ml]	$1,48.10^4 \pm 3,07.10^4$	75,47	0	24,53
Viral Load < 5 $\log_{10}$ I/ml	3,58 ± 1,69	90,57	0	9,43

3.3. Correlation Between Markers of Infection Progression

The search for links between markers of the evolution of the infection revealed a significant association between the increase in viral load in log10 IU/ml and the increase in uraemia. There was also a significant association between the increase in the quantity of HBs antigen and the number of copies of the virus (Table 2).

Table 2. *Correlation between markers of infection progression.*

	HBsAg	VL copies/ml	VL log	AST	ALT
Uremia	0,81	0,92	0,040*	0,76	0,74
Creatininemia	0,44	0,13	0,9	0,52	0,27
Total protein	0,62	0,66	0,88	0,36	0,47
AST	0,59	0,78	0,78		
ALT	0,75	0,59	0,97		
HBsAg		0,00*			

*: Significant ($p< 0.05$)

4. Discussion

The distribution of patients in the study by age group (Figure 1) made it possible to make the following observation: the age group 0-20 years represented 1.89% of the patients against 32.07% for that of 20-30 years. The age groups 30-40, 40-50 and 50-60 represented respectively 35.85%, 24.53% and 5.66% of the study population. The 20–40-year-olds constituted 68% of all patients. Doukou and al in 2023 [8], Salamanta and al in 2018 [13], and Fanou and al in 2019 [14] reported similar prevalence in their respective works. The relative youth of the study volunteers may be related to how blood donors are recruited. Indeed, the enrollment was carried out in very physically active blood donors. The profile of renal and hepatic markers in patients (Table 1) noted that:

1. uremia and creatinine were not unique. The same was true for transaminases (AST and ALT). This situation

was corroborated by a lack of correlation between markers of renal function and transaminasemia on the one hand and between the same markers and HBs antigenemia on the other hand. This would indicate that the evolution of hepatitis B is independent of renal damage a priori. Nambei and al in 2014 [15] reported that only 10% of biochemical analyses had abnormal values in adults in Bangui (Central African Republic) in biochemical investigations looking for the place of viral hepatitis B alone or associated with HIV among the causes of liver and kidney diseases in adults. Furthermore, the WHO recommendations in 2018 [16] indicated that markers such as AST, ALT, and γ-GT (Gamma Glutamyl Transferase) each had an independent evolution and should be interpreted as such.

2. Most of the study population had a lowered natraemia (73.58%) and a lowered total protein level (86.79%). Previous studies, in particular those by Sogoba and al in 2020 [17] on electrolyte disorders in a group of patients hospitalized for HIV infection in Bamako, had shown a significantly lowered natraemia. The low total protein values may be related to liver damage, leading to dysfunction of the liver.
3. In addition, 24.53% of volunteers had a high amount of HBs antigen. This increase confirmed the result of qualitative serological screening that was used to include volunteers in the study. The quantification of the HBs antigen made it possible to complete the information provided by the detection of viral DNA. If the viral load indicates the number of circulating virions, the title of the HBs antigen measures the fraction of envelopes that surround the virus, and that, more important, that circulate in the form of spheres or rods. The quantification of the HBs antigen allows to better characterize the status of the patient and in particular the inactive carrier of the virus. It can also predict the response to interferon therapy, the optimal duration of this treatment and the possible loss of HBs antigen [18]. The quantification of HBs antigen would become, along with viral load, an essential tool for the assessment and follow-up of patients with chronic viral hepatitis B; a low level of HBsAg (500-1000 IU/ml), associated with a low viral load (< 2000 IU/ml) and normal transaminasemia would indicate an inactive portage while a very low rate (< 100 IU/ml) would be in favor of a good prognosis according to the work of Chan et al in 2011 [18].

Significant viremia was observed in volunteers (3.58 $\log_{10} \pm$ 1.69 $\log_{10}$ IU/ml) with 9.43% of patients presenting a high viral load (> 5 $\log_{10}$ IU/ml). Salamata et al in 2018 [12] found an average rate of 4.5 $\log_{10}$ IU/ml in 78 cases in Senegal.

An association between increased viral load and increased uremia was observed (p=0.040). There was also a link between the increase in the amount of HBs antigen and the number of copies of the virus (p=0.00). The link between viral load and increased uremia had already been reported by Sehonou et al in 2018 [19] who estimated the prevalence of kidney failure in people living with HBV at 39%. Age, high blood pressure, and co-medication were identified as factors associated with kidney function decline. The link between the increase in the amount of HBs Antigen and the number of copies of the virus corroborated the fact that HBs antigenicity reflected the number of HBV envelope proteins and excess detectable coating particles in the blood during hepatitis B acute and chronic.

5. Conclusion

The study showed that viral hepatitis B was a condition that affected populations with renal (uremia, creatinine) and hepatic (transaminases) assessments within the limits of normal. The ionic balance was disrupted (decreased natremia) while the quantitative antigenemia HBs and viral load remained high. Early detection and management of the disease and biological monitoring of infected populations would be an important step towards its eradication in sub-Saharan Africa. Similarly, larger studies would refine the values of the different parameters that were determined in this study and identify predisposing risk factors in the volunteer blood donor population.

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Conflicts of Interest

The authors declare no conflicts of interest**.**

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