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Significance of parenteral viral hepatitis laboratory diagnostics in the Republic of Guinea

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Abstract

Rationale. Countries of Africa, especially countries in sub-Saharan Africa, represent a region characterized by high incidence of chronic hepatitis B virus (HBV) and hepatitis C virus (HCV) infections. Methods for detection of HBV and HCV in low and middle-income countries differ from those that are used in countries having access to high-cost technologies. The Republic of Guinea is a region with high prevalence of hepatotropic viruses; however, the information on HBV and HCV prevalence in the area is extremely limited, thus emphasizing the significance of this study.

The purpose of the study is to evaluate the need for improving laboratory diagnostics of parenteral HBV and HCV infections in the Republic of Guinea.

Materials and methods. A total of 2,616 samples of blood serum were tested; the samples were collected from apparently healthy residents of the Republic of Guinea during the routine medical checkup. The testing included qualitative detection of HBsAg, anti-HBs IgG, anti-HBcore IgG, anti-HCV IgG antibodies as well as HBV DNA and HCV RNA.

Results. The detection frequency of serological markers of HBV and HCV infections was 80.77% and 18%, respectively. However, HBsAg was detected only in 16.01% of individuals. Tests for detection of HBV DNA were performed among seropositive patients and patients seronegative by other HBV markers, HBV DNA was detected in 22.36% of cases, including 6.07% of HBsAg-negative cases. HCV RNA was detected in 2.2% of cases. Both HCV RNA and HBV DNA were detected in 27 people, including 19 HBsAg-negative cases, thus accounting for 1.03% of the examined group.

Conclusions. The markers that are currently used for laboratory detection of HBV and HCV in the Republic of Guinea are not efficient enough to diagnose reliably all cases. Undoubtedly, there is an urgent need to improve laboratory diagnostics for timely detection of parenteral ***v***iral hepatitis. Routine laboratory operations need assays for additional serological and molecular markers of HCV and HBV infections.

Keywords: *hepatitis C virus, hepatitis B virus, serological markers, molecular markers, laboratory diagnostics, the Republic of Guinea*

Ethics approval. The study was conducted with the informed consent of the patients. The research protocol was approved by the Ethics Committees of Institute of Applied Biological Research of Guinea and St. Petersburg Pasteur Institute (protocol 11/15, 12.02.2015).

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Научная статья
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Значимость лабораторной диагностики парентеральных вирусных гепатитов в Гвинейской Республике

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Аннотация

Актуальность. Страны Африки, особенно к югу от Сахары, являются регионом с высокими показателями заболеваемости хроническими вирусными гепатитами В (ВГВ) и С (ВГС). Методы выявления ВГВ и ВГС в странах с низким и средним уровнем дохода отличаются от тех, которые применяют в странах, имеющих доступ к дорогостоящим технологиям. Гвинейская Республика — регион с высокой встречаемостью гепатотропных вирусов, однако данных о распространённости ВГВ и ВГС на территории крайне мало, что определило актуальность данного исследования.

Цель работы — оценить необходимость совершенствования лабораторной диагностики парентеральных ВГВ и ВГС в Гвинейской Республике.

Материалы и методы. Исследовали 2616 образцов сыворотки крови, полученных от практически здоровых жителей Гвинейской Республики в рамках плановой диспансеризации. Исследование включало качественное определение HBsAg, антител анти-HBs IgG, анти-HBcore IgG, анти-HCV IgG, а также ДНК ВГВ и РНК ВГС.

Результаты. Выявляемость серологических маркеров ВГВ и ВГС составила 80,77 и 18% соответственно. Однако $HBsAg^+$ обнаружен только у 16,01% лиц. ДНК ВГВ выявляли среди как серопозитивных, так и серонегативных по другим маркёрам ВГВ пациентов, ДНК ВГВ обнаружили в 22,36% случаев, в том числе в 6,07% случаев $HBsAg^-$-ВГВ. РНК ВГС выявили в 2,2% случаев. Одновременно РНК ВГС и ДНК ВГВ определили у 27 человек, включая 19 $HBsAg^-$-случаев, что составило 1,03% обследованной группы.

Выводы. Применяемые в настоящее время в Гвинейской Республике маркёры лабораторного выявления ВГВ и ВГС не позволяют достоверно диагностировать все случаи. Очевидна необходимость совершенствования лабораторной диагностики для своевременного обнаружения парентеральных вирусных гепатитов. Целесообразно внедрение в рутинную работу лабораторий анализа на дополнительные серологические и молекулярные маркёры ВГС и ВГВ.

Ключевые слова: *вирус гепатита С, вирус гепатита В, серологические маркёры, молекулярно-биологические маркёры, лабораторная диагностика, Гвинейская Республика*

Этическое утверждение. Исследование проводилось при информированном согласии пациентов. Протокол исследования одобрен Этическими комитетами Института прикладной биологии Гвинеи и Санкт-Петербургского научно-исследовательского института эпидемиологии и микробиологии имени Пастера (протокол № 11/15 от 12.02.2015).

Источник финансирования. Авторы заявляют об отсутствии внешнего финансирования при проведении исследования.

Конфликт интересов. Авторы декларируют отсутствие явных и потенциальных конфликтов интересов, связанных с публикацией настоящей статьи.

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Introduction

Over the past few decades, the burden of viral hepatitis has increased significantly; at present, viral hepatitis is the 7th leading cause of death worldwide. As estimated by WHO, acute and chronic forms of hepatitis B virus (HBV) and hepatitis C virus (HCV) infections are responsible for 1.4 million deaths each year[1]. Among them, there are deaths associated with cancers and liver cirrhosis. Out of them, approximate-

[1] World Health Organization. Hepatitis C. Key facts. http://www.who.int/news-room/fact-sheets/detail/hepatitis-c (access date: 26.12.2020); World Health Organization. Hepatitis B. Key facts. http://www.who.int/news-room/fact-sheets/detail/hepatitis-b (access date: 26.12.2020).

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ly 47% are caused by HBV, while 48% are caused by HCV. The preliminary estimates show that the total number of deaths caused by viral hepatitis can reach approximately 20 million people in 2015–2030[2].

Chronic hepatitis B (CHB) and C (CHC) belong to diseases characterized by parenteral transmission of the virus, i.e. when the virus is transmitted through blood and/or other bodily fluids coming into contact with broken skin or mucous membranes. The natural routes of transmission include sexual activity (direct sexual contact), a vertical route (from mother-to-child during or after birth, and prenatal (transplacental) route) as well as household exposure, either direct or indirect, including shared use of personal care items and contacts with an infected person. The artificial routes include infection during intravenous injections of psychoactive drugs, during medical manipulations involving use of instruments contaminated with infected blood, during transfusion of blood and its components, etc. [1].

HBV and HCV infections can lead both to acute and chronic liver diseases; in both cases, during the acute phase of infection, most people have no symptoms [2]. According to global statistics, around 15–45% of HCV infected people can spontaneously clear the virus within 6 months after the infection, without any treatment. The other 55–85% of people develop CHC [3]. CHB is very common in infants infected from their mothers or before the age of 5 year when the likelihood of progressing from acute hepatitis B (AHB) to chronic hepatitis is more than 90%. Infection developing at an adult age can lead to chronic hepatitis in less than 5% of cases [4].

HBV and HCV infections occur worldwide; their prevalence varies depending on the region. The regions with high CHB and CHC incidence rates are countries of Africa, especially those of sub-Saharan Africa. At present, for diagnosis of viral hepatitis, the national clinical guidelines mandate performing a set of laboratory tests aimed at evaluation of the functional status of the liver and intended to identify the pathogen and its status [5]. It should be noted that the methods of HBV and HCV detection as well as the diagnostics of the associated liver diseases in middle and low-income countries differ fundamentally from those that are used in countries with access to high-cost technologies requiring special-purpose equipment and skilled personnel. Most of the related tests in countries of Africa are limited to detection of hepatitis B surface antigen (HBsAg) and antibodies to the hepatitis C virus (anti-HCV IgG), while molecular and genetic methods providing more accurate assessment of virus prevalence are available only in core laboratories in big cities [6]. Furthermore, even data on prevalence of serological HBV and HCV markers in a population are almost non-existent, as serological tests are frequently limited to certain groups of population – risk groups (HIV-infected people, prisoners, injection drug users, etc.) and groups where the prevalence of infection has a substantial impact on the health of the population (blood donors, pregnant women).

The Republic of Guinea is a region with high occurrence of hepatotropic viruses; however, the data on HBV and HCV prevalence in the country are extremely limited, thus emphasizing the significance of this study.

The purpose of the study is to evaluate the need for improving laboratory diagnostics of parenteral HBV and HCV in the Republic of Guinea.

Materials and methods

The study was performed by using 2,616 samples of blood serum collected from apparently healthy people living in the Republic of Guinea. The samples were collected from April 2015 to October 2020, from individuals not suspected of having Ebola virus disease. All the examined individuals were original residents of the Republic of Guinea and mainly represented by Fulbe, Malinke and Susu ethnic groups.

The age of the examined individuals ranged from 1 to 65 years, averaging 32.7 ± 16.4 years. The number of men in the group exceeded the number of women - 67.97 and 32.03% (95% CI, 66.15–69.73), respectively.

The examined individuals denied having HBV and HCV infection in their medical history. The fasting blood samples were drawn from the median cubital vein, in the amount of 5 mL, by using a vacuum-extraction blood sampling system, and collected in disposable tubes containing K_2-EDTA as an anticoagulant. Plasma was separated by centrifugation at 4ºC at 3,000 rpm for 10 min. The samples were aliquoted into cryotubes for storage at –20ºC and for further examination: for EIA — 500 μL, for PCR — 300 μL. The samples were transported at 4–8ºC in specialized containers for transportation of biomaterials.

The laboratory tests and studies were performed at the Russian-Guinean Scientific and Research Center of Epidemiology and Infection Disease Prevention of the Institute of Applied Biological Research of Guinea (IRBAG). This study was approved by the local Ethics Committee of IRBAG and the Pasteur Institute of Epidemiology and Microbiology. All the participants provided their written informed consent to participation in the research.

The examination of the patients' blood for serological markers of viral hepatitis by using the EIA technique included qualitative detection of HBsAg, anti-HBs IgG antibodies, anti-HBcore IgG antibodies, and anti-HCV IgG antibodies by using DS-EIA-HBsAg, DS-EIA-ANTI-HBsAg, DS-EIA-ANTI-HBc, and EIA-ANTI-HCV commercial kits (Diagnostic Systems RPC) and Vectohep B-HBs-antigen, VectoHBsAg-antibodies, HepaBest anti-HBc-IgG, and Best anti-

[2] CDC: How viral hepatitis impacts millions of people worldwide. https://www.cdc.gov/hepatitis/awareness/worldhepday.htm (access date: 26.12.2020)

HCV kits (Vector-Best JSC), according to manufacturer instructions.

The PCR tests for molecular markers were performed after HBV DNA and HCV RNA had been isolated by using an AmpliPrime Ribo-prep commercial kit (Central Research Institute of Epidemiology). HCV RNA was detected by using the real-time PCR technique with fluorescence detection with AmpliSens® HCV-FL kit (Central Research Institute of Epidemiology) in accordance with the user's manual. HBV DNA was initially detected by using real-time PCR with fluorescence detection using AmpliSens® HBV-FL kit (Central Research Institute of Epidemiology) in accordance with manufacturer instructions. Later on, we used the technique developed at the Pasteur Institute of Epidemiology and Microbiology for detection of HBV DNA in biological materials at low viral loads, including cases of HBsAg-negative or occult CHB [7]. Nucleotides to follow the complete genomes of some (three) HBV isolates from HBsAg-negative individuals identified during the work were deposited in the GenBank international database under numbers MN507840–

The data were statistically processed with MS Excel, Prizm 5.0 (GraphPad Software Inc.), Statistica 8.0 (StatSoft Inc.) software. To measure the significance of the differences in quantitative variables received from pairwise comparison, we used, depending on the sample pattern, Fisher's exact test or Yates' chi-square test (χ^2_{Yates}). The probability value $p < 0.05$ was set as the significance threshold.

Results

The analysis of the overall prevalence of serological markers showed that among the patients, the HBV and HCV markers accounted for 80.77% and 18%, respectively. Both HBV and HCV serological markers were detected in 5.12% of individuals, i.e. in 6.34% of HBV seropositive patients. However, HBsAg was detected only in 16.01% of individuals. Both HBsAg and anti-HCV IgG were detected in 2.75% of individuals, i.e. in 3.4% of the HBsAg-positive individuals.

The results of the distribution analysis for HBV markers in the examined group are shown in the **Table**.

The analysis of the gender-specific prevalence of serological markers showed that they were detected in 80.93% of men and 80.42% of women; HBsAg was detected in 18.61% of men and 10.5% of women; anti-HCV antibodies were detected in 19.06% of men and 15.75% of women.

We did not find any gender-specific differences in detection frequency of HBV serological markers; the frequency is high both in men (80.93%) and in women (80.42%). However, the prevalence of HBsAg in men (18.61%) exceeds significantly the prevalence in women (10.5%), $\chi^2 = 27.285$, $p < 0.0001$, df = 1. The relative risk of HBV infection with development of HBsAg-positive CHB is higher in men than in women: RR = 1.773, $p < 0.0001$, 95% CI, 1.422–2.210.

In the examined group, anti-HCV was significantly more frequently detected in men (19.06) than in women (15.75%): $\chi^2 = 4.017$, $p = 0.045$, df = 1, RR = 1.21, 95% CI, 1.007–1.454.

The analysis of the prevalence of serological markers by age groups showed that children under the age of 18 accounted for 12.97% among HBV seropositive patients; patients of 18–22 years old accounted for 3.03%; patients of 23 to 40 years old — 43.02%; patients older than 41 years — 40.98%. Thus, in the group of children under the age of 18, the detection frequency of HBV seropositive markers was 70.43%, while among the patients of 18–22, 23–40, and over 41 years of age, the detection frequency was 54.7%, 79.59%, and 89.46%, respectively.

In our study, the detection frequency of HBV serological markers was overall comparable among the examined patients of 23–40 years (79.59%) and in the age group over 41 years of age (89.46%); however, the risk of detection of HBV serological markers among patients over 41 years is slightly higher: $\chi^2 = 37.444$, $p < 0.0001$, df = 1, RR = 1.124, 95% CI, 1.084–1.166. The detection frequency of markers in the children and youth group (1–18 years of age) is slightly lower

Distribution of HBV serological markers in the examined group and among HBV seropositive patients

Detected serological markers in the blood serum	Examined group (n = 2,616), percentage of the total number of examined	Seropositive patients (n = 2,113), percentage of patients with HBV markers
$HBsAg^+$	2.14	2.65
$HBsAg^+$, $HBcore\ IgG^+$	8.18	10.13
$HBsAg^+$, $HBs\ IgG^+$	1.95	2.41
$HBs\ IgG^+$	7.99	9.89
$HBcore\ IgG^+$	40.82	50.54
$HBcore\ IgG^+$, $HBs\ IgG^+$	15.94	19.73
$HBsAg^+$, $HBcore\ IgG^+$, $HBs\ IgG^+$	3.75	4.64
Seronegative	19.23	–

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(70.43%). The likelihood of detection of HBV serological markers among patients of 23–40 years is higher than in the children group: $\chi^2 = 13.346$, $p = 0.0003$, df = 1, RR = 1.13, 95% CI, 1.053–1.213. It is obvious that the likelihood is even higher in the group over 41 years of aged as compared to the group of children under 18 years: $\chi^2 = 73.36$, $p < 0.0001$, df = 1, RR = 1.27, 95% CI, 1.187–1.359.

When the samples were examined for presence of HBV DNA by using the AmpliSens® HBV-FL kit, the virus was detected in 426 (16.28%) samples, including all HBsAg-reactive samples and in 7 HBsAg-negative patients. When we used the technique developed at the Pasteur Institute of Epidemiology and Microbiology for detection of HBV DNA at low viral loads, the virus was detected in another 159 (6.07%) people who were seronegative based on the results of EIA and PCR tests. Thus, HBV DNA was detected in 585 (22.36%) people. Tests for detection of HBV DNA were performed among the patients both seropositive and seronegative for other HBV markers.

The group of anti-HCV-positive patients does not include children under 18 years of age; patients aged 18–22 years accounted for 2.97%, while patients aged 23–40 years and patients over 41 years accounted for 55.2% and 41.82%, respectively. It was found that the detection frequency of anti-HCV antibodies increased with age — antibodies were absent in the group under 18 years; they were detected in 11.96% of patients aged 18–22 years, in 22.76% of patients aged 23–40 years and in 20.35% of patients over 41 years of age. The comparative analysis of the groups of patients aged 18–22 and 23–40 years showed an increase in the detection frequency of anti-HCV IgG — $\chi^2 = 6.651$, $p = 0.0099$, df = 1, RR = 1.903, 95% CI, 1.150–3.147.

When the samples were examined for the presence of HCV RNA by using the AmpliSens® HCV-FL kit, the virus was detected in 58 (2.2%) samples.

Both HCV RNA and HBV DNA were detected in 27 (1.03%) patients, including 19 HBsAg-negative patients.

Discussion

The hepatitis B surface antigen (HBsAg) is the main laboratory marker in HBV diagnostics; its prevalence in a population varies depending on the geographic region. The detection of HBsAg in blood is seen as the sign of activity of the virus. In peripheral blood, HBsAg can be detected 2–4 weeks before clinical symptoms of the disease are displayed. Its concentration in AHB patients reaches maximum values to decrease further within 4–6 months to the level not detectable by commercial test-systems, during recovery or HBsAg clearance. It should be remembered that the absence of the detectable level of HBsAg in peripheral blood does not mean full recovery, as it can also be indicative of development of occult CHB [8, 9]. The occult or HBsAg-negative CHB is characterized by an undetectable level of HBsAg in blood plasma, when HBV DNA is present in liver tissue and the viral load in the blood is extremely low, almost undetectable, regardless of the presence or absence of any other serological markers [10]. Antibodies to HBsAg (anti-HBs IgG), including their quantification in blood, are used as markers for the previous HBV or as a proof of vaccination against the virus. Antibodies to HBcAg (anti-HBcore IgG) are indirect markers for a patient's exposure to HBV when results for other markers are negative [11].

In our study, the HBsAg prevalence among relatively healthy people was 16.01%, which is comparable with the studies conducted in the late 20th century and demonstrating that the HBsAg prevalence in different regions of the Republic of Guinea was 16.7%, on average. [12]. Thus, during the past twenty years, the HBsAg detection frequency in the region has been steadily high. Previously it was found that the HBsAg prevalence in countries of Africa is higher in men than in women, especially in rural regions, which was explained by differences in tribal and sexual behavior among men and women [13, 14]. It could be assumed that the absence of significant gender differences in the detection frequency of HBV serological markers in our study can be explained by the fact that the examined patients could not be conclusively placed into the category of rural residents as well as by the higher level of education and relative universalization of behavior of people engaged in the mining industry. Apparently, the social characteristics of the examined group do not have a sufficiently significant impact on the decrease in the virus prevalence and are not significant for evening out the gender-specific difference in HBsAg detection frequency. The similarity of the prevalence of the analyzed serological markers, in total, implies that the HBV-related situation in the region generally does not differ from the situation in other countries of West Africa where CHB is detected in 10–25% of residents and over 75% of the population was exposed to the virus [15]. Based on the detected serological markers, HBsAg-positive CHB was detected in 16.01% of patients of the examined group, i.e. in 19.83% of seropositive patients; among patients exposed to HBV without HBs-antigenemia ($HBsAg^-$, HBcore IgG^+) and among AHB convalescents ($HBsAg^-$, HBcore IgG^+, HBs IgG^+) — in 56.76% of the examined group, i.e. in 70.27% of seropositive patients, which is confirmed by the fact that antibodies were detected only in 15.94% of cases. Among the patients of the examined group, 72.78% of patients had exposure to HBV.

The virus prevalence estimated with reference to publications can vary among the population depending not only on the gender, but also on the age. For example, in rural areas in southwestern Chad, the overall prevalence of HBsAg was 22.9%, while the youngest age

group (6–15 years) and the group of boys/men demonstrated significantly higher HBsAg prevalence rates as compared to older groups and the group of girls/women ($p < 0.01$) [16].

Our results for the prevalence of HBV markers among age groups are consistent with the previously published data showing that HBV in Africa is generally transmitted in early childhood; children are at high risk of being infected with HBV through parenteral horizontal transmission (including transmission via household/close contact), especially at the age of 2-10 years [17]. Apparently, children with high viremia levels transmit the virus through cuts and abrasions to the susceptible brothers, sisters, and teammates. Although the horizontal transmission is the main mode of virus transmission, it is believed that around 10% of chronic cases result from the perinatal transmission, and the low detection frequency of HBeAg in HBsAg-positive pregnant women correlates with the low frequency of perinatal transmission in most of the African countries. Therewith, 20–30% of patients infected in early childhood become chronic carriers, and only 10% of them remain HBeAg-positive when they reach adolescence [18]. In the meantime, the overall picture lacks the data obtained for the group of 18-22 years old, in which the prevalence of serological markers was as low as 54.7%. At the same time, this age group was represented by the smallest number of patients. Presumably, the significant decrease in the detection frequency of HBV serological markers in this group can be explained by the limited number of samples, thus demonstrating the need in thorough analysis and selection of the examined groups.

It should be noted that the HBsAg detection frequency among individuals under 18 years of age was 16.9% according to our results, thus providing another proof of predominant infection in childhood. Ii is insignificantly higher than the respective detection frequency in children from South Africa (15.7%), the prevalence in the latter is seen as highest of those described in literature [19]. Interestingly, in African countries, the HBsAg prevalence among infants (16.3%) and blood donors (23.4%) can significantly exceed the prevalence among the population (13.6%), for example, in Nigeria [20].

The PCR technique is widely used for molecular diagnostics of viral hepatitis. The testing performed with the AmpliSens® HBV-FL commercial kit showed that the HBV DNA prevalence in the group (16.28%) is comparable with the HBsAg detection frequency (16.01%), though we also detected 7 HBsAg-negative, HBV DNA-positive patients, thus demonstrating that the PCR technique has higher sensitivity as compared to the classic HBV diagnosis algorithm based on HBsAg detection by using the EIA technique. Nevertheless, both techniques are not sufficiently sensitive, and it is proved by the detection of HBV DNA in another 159 seronegative patients (6.07% of total samples) when we used the technique developed at the Pasteur Institute of Epidemiology and Microbiology for detection of HBV DNA at low viral loads. Thus, the prevalence of HBV DNA in the examined group (22.36%) exceeds the previously published prevalence rates for the virus in the region [12]. Although some authors believe that heterogeneity in the results obtained by different researchers in the same country is, first of all, associated with geographic regions, socialization, and universal immunization rather than with the gender of patients, with methods and techniques for screening of HBV markers and with methodological quality of studies [21], we think that differences in results can be caused by the differences in applied methods of laboratory diagnostics. The high rates of occult CHB in the examined groups is typical of the regions where the virus is widespread. Take notice of cases when HBV DNA was detected in patients with the only positive serological marker - anti-HBs IgG, the presence of which in peripheral blood without any other serological markers is usually seen as the sign of the immune response caused by vaccination against HBV; there were also 6 cases when HBV DNA was detected in patients with both anti-HBs IgG and anti-HBcore IgG, the combination of which should indicate the protective immunity of AHB convalescents.

The screening laboratory diagnostics of HCV infection is based on detection of antibodies to the virus, including verification of controversial results with assays for antibodies to different viral proteins by using the immunoblotting method. Detection of HCV RNA is a confirmatory diagnosis method, which is used to shorten the period of the "serological window" or to separate AHC convalescents from CHC patients [22].

In our study, the prevalence of anti-HCV IgG was 18%, thus significantly exceeding the previously published data [23]. Our results regarding the higher prevalence of anti-HCV in men as compared to women contradict the published data on the significance of the gender for HCV prevalence, but are in agreement regarding the older age as the risk factor of seropositivity [24].

Note that the EIA anti-HCV assays used in our study detect total antibodies to HCV proteins, which is not sufficient for reliable detection of all HCV markers; the results need verification, for example, by the detection of specific antibodies to different HCV proteins by using an immunoblotting assay. Apparently, most of the detected cases can belong to seropositive AHC convalescents or to CHC patients with the viral load lower than the detection level of the commercial assay used for detection of HCV RNA (100 IU/ml), as HCV RNA was detected only in 2.21% of patients (12.31% of anti-HCV-positive cases). The low prevalence of HCV is typical of this geographic region [24]. However, like in case with HBV, there can be prevalence of HCV with a low viral load, which we are not able to detect by

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using commercial assays. The indirect proof can be found in the identified difference in anti-HCV prevalence in age groups as well as in the tendency to detect anti-HCV more frequently in men than in women, which can be, obviously, explained by social and behavioral characteristics of residents of the region. The above assumption can be verified through studies employing the nested-PCR and making it possible to improve the sensitivity of the technique and detect HCV RNA at low loads. Additional studies involving the analysis of HCV RNA in blood mononucleocytes would also increase the accuracy of assessment of the pathogen prevalence in the region [22].

Speaking about the prevalence of parenteral viral hepatitis in the region, we should mention the high incidence of hepatocellular carcinoma (HCC) in countries of Africa; it has an important role in the mortality associated with liver diseases. The worst affected country is the Gambia followed by the Republic of Guinea, Liberia and Sierra Leone [25]. While in countries of Europe and America, HCC is mainly associated with HCV, in countries of Africa, HBV is a much more frequent cause of HCC [26, 27]. Especially significant is occult CHB detected in more than 75% of HBsAg-negative patients with HCC [28]; most of the HCC patients in the region die within several weeks after they have been diagnosed with the disease, i.e. the mortality from HCC is comparable with its incidence. This is connected with early HBV infection, late detection of the virus, delayed visit to the doctor and maltreatment, and insufficient application of diagnostic methods.

Conclusion

Analyzing the prevalence of serological and molecular markers of HBV and HCV infections in the Republic of Guinea, we have to conclude that studies in the region are limited not only because of the small number of the examined people, but also because of the available diagnostic tests. It is obvious that the improvement of laboratory diagnostics is of high significance and emergency for timely detection of parenteral viral hepatitis; assays for additional serological and molecular HCV and HBV markers must be included in routine laboratory operations. The advanced molecular, technically sophisticated methods and techniques will provide an access to additional data, thus contributing to the understanding of molecular epidemiology of the infection process and facilitating the development of programs for prevention and treatment of viral hepatitis.

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