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Modern Principles of Ensuring Blood Component Infection Safety

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Annotation. The main causative agents of parenteral infections are human immunodeficiency viruses, hepatitis B and C viruses. The impossibility of replacing blood with synthetic components and parenteral infections determines the relevance of increasing the safety of blood transfusion.

Key words: Donor, recipient, blood transfusion infections, hepatitis B, hepatitis C, human immunodeficiency virus.

The importance of study: The safety of transfusion of blood components is an integral part of transfusiology, and depends on measures for the selection of donors, technologies that increase the safety of donor blood, quality laboratory diagnostics of hemotransfusion infections, as well as rational clinical use of blood components.

Transfusion of blood components is the main part of transfusiology, what is carried out by qualified specialists in hospitals [14]. Blood preparations are assessed as unsuitable when cases of hemotransmissive infections, biochemical indicators, chillosis, hemolysis, fibrinolysis are observed in the blood preparation [6]. The most dangerous type of hemotransmissive infections include hepatitis B, C and D, human immunodeficiency virus infection, brucellosis, malaria [12, 15]. Although there have been many studies in the last 10 years aimed at early diagnosis, treatment and diagnosis of complications of chronic viral hepatitis [1, 3, 5], some laboratory results in the literature have not been studied until the end [2, 4].

One of the main conditions of transfusiology is the preparation and transfusion of blood components that meet modern quality and safety requirements for blood transfusion therapy. Over the past 10 years, the improvement of Tibetan technologies has made it possible to increase these capabilities [13].

The main causative agents of parenterally transmitted infections are human immunodeficiency virus (HIV) types 1 and 2, as well as hepatitis B (HBV) and hepatitis C (HCV) viruses. Almost 40 million people are living with HIV infection [8, 16], 248 million people are chronically infected with HBV [17], and 110 million people have antibodies against HCV, of which 80 million have actively replicating virus [7]. Compared to HIV infection, viral hepatitis B is 6.7 times more common, and viral hepatitis C is 3 times more common. Despite their similar clinical manifestations, hepatitis B (HBV) and hepatitis C (HCV) viruses have a number of fundamental differences. It is a strategy for the implementation of genetic information and, accordingly, has pathogenetic differences both at the level of the affected cell and at the level of the whole organism. Acute hepatitis B is characterized by symptoms of acute liver damage and poisoning, the appearance of jaundice, severe clinical manifestations of the disease, and a sharp increase in serum aminotransferase activity. Acute hepatitis C can be manifested by general discomfort, increased fatigue, loss of appetite, in rare cases, nausea, vomiting, jaundice, and a slight increase in aminotransferase activity in blood serum [18]. Chronic hepatitis B (SGB), like chronic hepatitis C (SGC), is a long-term inflammatory liver disease that can lead to cirrhosis and liver cancer. Clinically, SGB and SGC are manifested by weakness, general weakness, decreased appetite, increased liver size, jaundice, increased aminotransferase activity, but in most cases, the symptoms of the disease are mild.

The first latent HBV infection was described in 1978, when HBsAg was detected and acute hepatitis B developed after transfusion with HBV virus [11]. In 2008, the European Association for the Study of the Liver introduced the term "occult HBV infection". It was found that HBV DNA was present in the liver of patients without HBsAg detection in blood serum [10]. A latent form of hepatitis B and its components in a

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blood donor may not be detected by standard virological screening, and blood components from such a donor may be transfused to the recipient.

Latent HCV infection was first detected in 2004 by the Spanish scientist I. Castillo [9], based on the changes in the biochemical blood analysis of liver damage in 100 patients. Liver biopsy was performed on all patients included in the study, and HCV RNA was detected in 57% of cases in reverse transcription with polymerase chain reaction (PCR) in liver tissue. In 48 out of 58 patients, viral RNA chain was found in liver tissue. Since HCV has a positive genome, finding the viral genome as a stage of RNA synthesis confirmed the presence of viral replication. The latent form of HCV infection was detected by the presence of HCV RNA in liver tissue and mononuclear cells of peripheral blood.

Detection of anti-HBV in the blood can be caused by special vaccination against HBV. Antibodies to HBV e-antigen disappear from the bloodstream over time, so they are not considered to be an anamnestic indicator of previous hepatitis B/ for this reason, anti-HBV detection is the best among the spectrum of anti-HBV antibodies.

System of control of safety of blood components against hemotransfusion viruses.

The development of a system for improving the safety of transfusion of donor blood components is complex and includes various stages, from working with donors to storage and distribution of hemocomponents, to checking cases of transfusion transmission of infection.

1. Transfusion of donor blood components may increase the risk of viral transmission, working with donors.

Administrative measures to select donors with a low risk of infection are an effective way to improve blood transfusion safety before laboratory testing. Such measures include: attraction of unselfish donors, creation of favorable conditions at all stages of donation (reduction of queues, availability of wireless networks in waiting areas, absence of diversion by SMS and / or e-mail after donation, etc. The results of laboratory tests and the clinical application of the prepared components will make donors interested in visiting again. All these activities will create conditions for the formation of a target group of repeat donors.

2. Improving the efficiency of primary clinical and laboratory blood tests, which are part of the system to improve blood transfusion safety.

Primary clinical and laboratory tests are carried out before donating blood and its components. Transfusion of blood components requires that donors have normal peripheral blood parameters. An increase in the activity of alanine aminotransferase (ALT) in blood serum by 2 or more times is an indication against donation. In addition to routine tests, additional laboratory tests may be important. Deviations in the leukocyte formula may indicate the onset of an infectious disease caused by a parenteral pathogen. Below is an observation that reflects this assumption.

3. Checking the infectious safety of donor blood components at the viral screening stage.

One of the most objective ways to ensure the safety of blood transfusion is the virological examination of donor blood samples. As we mentioned earlier, no antibodies were detected in donors for HBV. It is necessary to rule out human immunodeficiency virus, HBV, HCV, brucellosis infection.

4. Increasing the safety of donor blood components during storage.

The components of donated blood collected for patients with tumor diseases of the blood system undergo leukoreduction, which significantly increases the infectious and immunological safety of blood transfusion. Additional ways to improve safety include pathogen reduction and irradiation of donor blood components. The highest concentration of viral particles is in donor blood plasma, therefore, obtaining blood components with additional or partial replacement of plasma with dilution solutions allows not only to increase the safety of these components, but also to increase their storage time.

At the same time, these components of donor blood cannot be used due to a decrease in the number of functionally active platelets and an increase in erythrocyte lysis.

5. Improving the safety of donor blood components for clinical use.

Effective measures to increase the safety of blood transfusions are to appoint them only if there are objective indications to the recipient. The appearance of markers of parenteral viral hepatitis in the blood of the recipient may be associated, first of all, with blood transfusions. However, the source of infection is not always the donor. An important condition for the proper control of viral infections is the necessary and sufficient primary virological screening performed before blood transfusion.

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The use of standard virological tests (HIV, HBsAg and anti-HCV) during hospitalization in the case of latent infection in a patient does not reveal the fact of infection of the patient. After HCV infection, in most cases, the viral process is chronic, but J. M. Micallef et al described cases of spontaneous viral clearance after primary acute HCV infection.

After primary infection, even when virions are lost in the blood, HCV has been reported to persist mainly in hepatocytes and dendritic cells. There is no agreement that HCV can be completely eradicated after infection. The establishment of immunological control over an active infection causes the virus to enter a latent state. This fact is confirmed by the presence of CD4 and CD8 lymphocytes, i.e. "long memory" cells specific against HBV antigens, which are found even several years after the primary infection. In the latent phase of infection, the virus synthesizes a small amount of antigens that cannot be detected by existing laboratory methods, but they are sufficient to maintain the reaction of T-cells specific to HBV. In the liver of infected people, except for HBV DNA molecules, all viral transcripts can be found.

Quantitative real-time PCR detects a small but still significant amount of viral mRNA. Thus, clinical recovery from HBV infection does not reflect complete elimination of the virus, but only the ability of the immune system to control viral replication in the liver after clinical recovery.

5.1. Examination of cases where the recipient is likely to be infected with hepatitis B or C virus.

The introduction of a protocol of virological testing of patients during hospitalization allows to identify patients infected with HBV and HCV, which allows for further monitoring, monitoring of the activation of the viral process and planning of specific antiviral therapy. The result of the implemented protocol is to determine the main appearance of HBV or HCV markers in patients. Currently, normative documents describing the algorithm of actions for identifying infectious signs have been developed and applied to HIV infection.

Between 2010 and 2020, new information was received on the spread of symptoms of blood-borne infectious diseases among the population (blood donors, medical workers and patients). These data showed an increase in HIV infection, hepatitis C, and syphilis, while overall rates of hepatitis B, C, and HIV were statistically significantly higher in men.

In short, there is a possibility of transmission of hemotransfusion infections through donor blood and its components, because there is no guarantee of complete elimination of infectious diseases. At the same time, there are a number of measures to improve the infectious safety of blood transfusion. The activities carried out at different stages differ significantly in nature and in terms of resources and labor costs. At the same time, all existing measures do not negate each other, but complement each other and create a general system of increasing the infectious safety of transfusion of blood and its components.

The introduction of new diagnostic markers, in particular anti-HBC, helps to identify latently infected people among donors of blood and its components, which reduces the risk of transfusion transmission of infections, including in cases of immunodeficiency. An indispensable condition for the effective control of the safety of blood transfusion is the implementation of comprehensive measures to firstly identify infected people among recipients of blood components and to investigate the possible causes of infection.

Conclusion.

1. The system for ensuring infectious safety of blood transfusion is being improved and optimized based on comprehensive prevention of post-transfusion complications caused by blood group factors and blood transfusion infections.

2. Infectious safety of blood transfusion is mainly determined by blood certification - the procedure for confirming the compliance of blood parameters of donors and patients with the requirements of regulatory documents by laboratory testing methods.

3. The "urgent" vaccination scheme (0-7-21 days) developed and included in clinical practice for hepatitis B patients, medical workers and blood donors increases the effectiveness of infectious safety. Donor vaccination provides an additional opportunity to obtain specific donor antihepatitis plasma and immunoglobulin for use in the comprehensive treatment and prevention of hepatitis B.

4. The recommended method of mathematical modeling of situations allows you to determine the optimal amount of diagnostic and preventive measures to ensure the infectious safety of blood transfusion.

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5. Detection of HIV markers is significantly higher among donors of rh-negative group 4 (AB) and much lower among donors of group 2 (A). There are no significant differences in the prevalence of ABO and Rh blood groups among donors with viral markers. The frequency of false-positive results in blood-borne infectious disease screening is high among hepatitis B, C donors.

7. The developed standard of the laboratory of transfusion immunology defines its structure, complex blood examinations of donors and recipients aimed at ensuring the immunohematological and infectious safety of hemocomponent therapy, tasks.

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