

Screening Parameters of Transfusion-Transmitted Infection using Rapid Diagnostic Method

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Abstract

Blood transfusions are an important part of medicine for patient recovery. Therefore, the transfused blood must be free from viruses, bacteria, and even parasites that can be transmitted through blood transfusions. Human Immunodeficiency Virus (HIV/AIDS), Hepatitis C, Hepatitis B, and Syphilis are among the illnesses that can be transferred through blood transfusions. This research aims to determine screening parameters for transfusion-transmitted infection using the rapid diagnostic test method. This type of research is experimental with a cross-sectional design. The samples used were ten blood samples, taken intravenously and then centrifuged at a speed of 1300 rpm for 4 minutes. After that, screening is carried out with a rapid diagnostic test. The screening results of the ten blood samples examined were valid and negative or non-reactive for HIV/AIDS, Hepatitis C, Hepatitis B, and Syphilis. These results indicate that the blood samples tested can be categorized as blood samples that passed the screening test or the blood examination test for four parameters of transfusion-transmitted infection.

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Introduction

Blood transfusion services are health service efforts that include planning, mobilizing, and preserving blood donors, providing blood, distributing blood, and medical procedures for giving blood to patients for the purpose of curing disease and restoring health. Giving blood transfusions according to indications can save lives and improve health status. The Global Database on Bloody Safety reports that 20% of the world's population in developed countries (80%) uses safe donor blood, and 80% of the population in developing countries (20%) uses safe donor blood. Blood safety is needed to minimize the occurrence of infectious diseases through blood transfusions, especially HIV/AIDS, Hepatitis C, Hepatitis B, Syphilis, Malaria, and Dengue Hemorrhagic Fever (DHF). One procedure to protect blood is a screening test for transfusion-transmitted infection through blood. Blood should not be used for transfusion if the transfusion-transmitted infection screening test results are reactive. Transfusion-transmitted infection screening tests to avoid the risk of transmission of infection from the donor to the patient are a critical part of the process of ensuring that the transfusion is carried out in the safest manner possible. Blood screening

tests for infections must at least be aimed at detecting HIV, Hepatitis B, Hepatitis C, and Syphilis (Kemenkes, 2015).

Transfusion-transmitted infection detection can be carried out against antibodies or antigens using various methods such as rapid tests, Enzyme Immunoassay (EIA), Chemiluminescence Immunoassay (CLIA), and against viral genetic material such as the Nucleic Acid Amplification Test (NAT). Rapid test is a method of screening for viruses or bacteria. According to the Agency for the Assessment and Application of Technology (BPPT), the rapid serology or antibody test (Rapid Diagnostic Test) is designed using an immunochromatography technology platform so that it can detect and provide fast results for viruses or bacteria in about 10 minutes. Rapid Diagnostic Test (RDT) is available in the form of strips or cassettes, which are used to determine the presence or absence of viruses or bacteria that cause IMLTD. A rapid test is a test that functions to screen potential transfusion transmitted infection reactive cases (Suarjana & Nauval, 2019).

The rapid diagnostic test method can be carried out for several blood samples. The blood sample is examined using a rapid diagnostic test tool to see whether there is an antibody reaction (immunoglobulin substance) which is formed when infected through a transfusion transmitted infection. Considering the large influence of viral or bacterial infections that can cause infections that are transmitted through blood transfusions, the role of screening is very important to minimize the occurrence of transmission. The process of screening for infectious diseases through blood transfusions can help detect diseases early so that treatment and even prevention can be carried out immediately. The rapid diagnostic test method is used in the screening process because it has the advantage of being able to detect pathogenic viruses or bacteria directly and not requiring a long time, being able to detect the acute phase, not requiring an incubation period to show positive results, and not requiring special laboratory specifications. Workmanship and does not require special skills in the workmanship implementation (Prugger et al., 2016). Therefore, based on this background, researchers want to conduct research related to screening for transfusion-transmitted infection using the rapid diagnostic test method.

Methods

The type of research is a true experiment with a cross-sectional study. A cross-sectional study is a type of research design in which data is collected from many different individuals at one time and observing variables without influencing the variable. The research used a minimum sample of 10 samples taken from 10 different individuals, and the variable of this research is transfusion-transmitted infections (3 samples for HIV, 2 samples for Hepatitis B, 3 samples for Hepatitis C, and 2 samples for Syphilis). Blood samples were taken intravenously and centrifuged at 1300 rpm for 4 minutes. After being centrifuged, the serum and blood plasma will be separated, while blood serum will be examined. Then, it is dropped into a cassette rapid diagnostic test kit. After the serum is dripped, a buffer is added to speed up the reaction between the antibodies and the sample antigen. It takes approximately 10 minutes to wait for the results. If the result is one line on the control line (C), then the result is non-reactive or negative, whereas if there are two lines on the control line (C) and test line (T) then the result is reactive or positive.

Results and Discussion

The screening of transfusion transmitted infection showed that valid negative results were obtained from 10 blood samples, showing one line at the C mark (Control line) for HIV, Hepatitis C, Hepatitis B and Syphilis. The results can be seen in Table 1.

Table 1. Screening Parameters of Transfusion Transmitted Infection using Rapid Diagnostic Method

Sample	Parameters Infection	Result
A	HIV	non-reactive
B	HIV	non-reactive
C	HIV	non-reactive
D	HBsAg	non-reactive
E	HBsAg	non-reactive
F	HCV	non-reactive
G	HCV	non-reactive
H	HCV	non-reactive
I	Syphilis	non-reactive
J	Syphilis	non-reactive

(Source: Data processing, 2023)

From [Table 1](#), there are ten blood samples, which are divided into 3 samples for the HIV test, 2 samples for the Hepatitis B test, 3 samples for the Hepatitis C test, and 2 samples for the Syphilis test. Examination of transfusion-transmitted infection parameters on ten samples was not carried out on every variable because the researcher only aimed to see how the rapid diagnostic test works in initial screening for transfusion-transmitted infections. The results of this study stated that the transfusion-transmitted infections examination of 10 blood samples was negative or non-reactive, with one line result on the control line cassette rapid diagnostic test. A rapid diagnostic test is a qualitative examination that cannot be measured to see the results, so the results can only be seen by the number of lines on the control line, test line, or both of them. The blood samples tested can be categorized as samples that pass the screening test or pass the blood examination test for transfusion-transmitted infections.

In Indonesia, there are four parameters for examining transfusion-transmitted infections such as HIV infection, Hepatitis B, Hepatitis C, and Syphilis. Human Immunodeficiency Virus (HIV) is a virus that attacks white blood cells, specifically CD4 cells, in the human immune system. This, of course, can make the body more susceptible to infection or disease. When someone is infected with the HIV virus and does not receive proper treatment, it can gradually lead to AIDS (acquired immunodeficiency syndrome). Transfusion-transmitted infection tests can produce false negative results, which most often occur when people test in the first few weeks after infection, during the 'window period.' The window period in HIV testing refers to the time between HIV infection and detection of the virus in an HIV test. During this period, a person can be infected with HIV, but the HIV test can still give a negative result because the body has not produced sufficient amounts of antibodies for the test to detect ([Manak et al., 2015](#)). Based on [table 1](#) shows the results of non-reactive examination of samples tested for HIV. There are two possibilities for this result, namely that the individual is healthy and does not have HIV, or at the time of blood collection and examination, the individual being examined does not mean that he does not have HIV. Conversely, this may mean they tested too early to detect HIV antigens or antibodies.

Hepatitis B surface antigen, also known as the HBsAg is a key marker for screening and laboratory diagnosis of HBV infection. HBsAg test is an examination procedure to detect the surface antigen of the hepatitis B virus (HBV) in the blood. This examination is important for early detection of hepatitis B which affects liver function. Rapid diagnostic tests (RDTs) represent promising alternatives to immunoassay-based methods. These immunoassays should be highly sensitive, specific and capable of detecting HBV variants carrying amino acid substitutions for the most recent tests ([Chevaliez et al., 2021](#)). Based on the results of the HBV examination, the examination results showed negative or non-reactive, meaning that the hepatitis B virus was no longer found in the body. This can also happen to someone who has completely recovered from this liver disease or indeed the individual being examined is not infected by the hepatitis B virus.

Syphilis screening is an examination to detect the presence of antibodies produced by the body to fight the bacteria that cause Syphilis. Syphilis itself is a sexually transmitted disease caused by the bacteria *Treponema pallidum*. When the *Treponema pallidum* bacteria infects a host, it will trigger the host to release a cellular and humoral immune response with the aim of killing the germ. *Treponema pallidum* itself has the ability to evade host responses and cause persistent infections. Diagnosis of Syphilis is based on disease history, characteristics of nervous disorders, and physical condition. This syphilis examination detects the presence of antibodies produced to fight syphilis infection. Based on the results of the syphilis examination, the examination results showed negative or non-reactive, meaning that no *Treponema pallidum* bacteria were found in the body. However, because this rapid diagnostic test is not the gold standard for syphilis examination, it is necessary to carry out a confirmatory test using the *Treponema Pallidum* Haemagglutination Assay (TPHA) ([Fadhilah et al., 2023](#)). Hepatitis C is a health problem that attacks the liver, namely infection and inflammation of the liver. In the early stages, the symptoms of hepatitis C are quite difficult to notice, hepatitis C sufferers generally do not have symptoms for years. Even if symptoms appear, they may be almost the same as fever in general, such as no appetite, body aches, and fatigue. Based on the results of the research, the results were non-reactive HCV. This is because you have never been exposed to the virus, and you do not have Hepatitis C. However, the results could be false (false negative), which means you may have HCV, but it was not detected by the rapid diagnostic test. So further tests need to be carried out ([Permatasai et al., 2015](#)).

From research by [Cendra \(2020\)](#), it was found that transfusion transmitted infection Hepatitis B screening results in blood donors at PMI Sleman with a total of 12,553 donors had 159 (1.3%) reactive results. Another research conducted by [Saputro and Lestari \(2023\)](#) in the 2021 – 2022 period, in 2021 found reactive transfusion-transmitted infection parameters of Anti-HbSag 0.07%, Anti-HCV 0.04%, Anti-HIV 5.34%, and Syphilis 10.15%. Meanwhile, in 2022, transfusion-transmitted infection reactive

parameters for Anti-HbSAg will be 0.07%, Anti-HCV 0.11%, Anti-HIV 5.34%, and Syphilis 5.59%. The percentage of transfusion-transmitted infection reactive numbers in 2021 is lower, and in 2022, it will increase. According to Irani et al. (2021), new donors have a potential risk of reactive hepatitis B than routine donors. The research results of Larasati et al (2016) found that the prevalence of Hepatitis C in blood donors at PMI Bantul Regency in 2019-2020 was 0.15%. The prevalence in 2019 was 12 (0.14%) and in 2020 it was 14 (0.16%). The percentage of Hepatitis C in male blood donors is higher than in women. In 2019 it was 11 (91.66%) and in 2020 it was 11 (78.6%). The highest prevalence of Hepatitis C in blood donors is at the age of 24-44 years; in 2019, it was 8 (66.7%), and in 2020, it was 12 (85.7%).

The transfusion-transmitted infection screening test aims to avoid the risk of transmitting infection from the donor to the patient in the safest possible way. This transfusion-transmitted infection test must be carried out by all blood service units in accordance with the criteria in Kemenkes (2015). At a minimum, the screening test for transfusion-transmitted infection must be aimed at detecting HIV, Hepatitis B, Hepatitis C, and Syphilis. Other types of infections, such as malaria, depend on the prevalence of the infection in each region. The research results in Table 1 contain an overview of valid non-reactive transfusion-transmitted infection screening results. A rapid diagnostic test (RDT) is a simple test tool; blood samples can be taken from venous blood or fingertip capillary blood and can provide results in a matter of minutes. The validity of RDTs varies based on the type of target antigen and the brand name of the RDT. The specifications for the Rapid Diagnostic Test method for anti-HIV test has a sensitivity and specificity $\geq 99\%$ and has been registered with the Ministry of Health and has been evaluated by the national regulatory authority and has been recommended and trained at blood transfusion units (Harti et al., 2014). The Rapid Diagnostic Test method for anti-HCV and anti-HBsAg testing has a sensitivity $\geq 99.5\%$ and a specificity $\geq 98\%$ and has been registered with the Ministry of Health and has been evaluated by the national regulatory authority and has been recommended and trained at blood transfusion unit (Wijayanti, 2016; WHO, 2023). The Rapid Diagnostic Test method for Treponema pallidum testing has a sensitivity $\geq 100\%$ and a specificity $\geq 99.8\%$ and has been registered with the Ministry of Health and has been evaluated by the national regulatory authority and has been recommended and trained at the blood transfusion unit.

Conclusions and Recommendations

Based on the sample results, the blood tested can be categorized as blood that passes the blood examination screening test. These results consisted of 3 samples passing the HIV screening test, 2 samples passing the hepatitis B screening test, 3 samples passing the hepatitis C screening test, and 2 samples passing the syphilis screening test. The suggestion given for further research is to examine transfusion-transmitted infections using the ELISA and ChLIA methods with more samples.

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