CPQ Medicine (2019) 6:1
Review Article

Safe Blood Transfusion Through Proper Donor Screening

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Received: 16 March 2019

Published: 19 March 2019

Keywords: *Safe Blood Transfusion; Infections; Donor Screening*

Abstract

Blood transfusion is paramount in saving lives especially when it is necessary. Life is so precious and should be handled with care. Safe blood transfusion is a major concern in transfusion medicine. Safe blood transfusion starts with proper selection of donor. Voluntary donors should be encouraged unlike the commercial donors who have greater risks of transmissible transfusion diseases and other related risks because of unhealthy life style and quest for money. All the necessary steps should be careful followed to achieve the aim of having safe blood for transfusion.

Introduction

The screening of donated blood and the quarantine of blood and blood components represent critical processes that should be followed to ensure that blood units are safe. Based on the screening results, they should either be released for clinical or manufacturing use or be discarded. Laboratory screening for TTIs should be performed on blood samples collected at the time of donation. All tests on blood samples should be performed and recorded in accordance with standardized procedures in laboratories that are properly equipped to undertake them [1].

All blood samples, donations and components should be correctly labeled to ensure correct identification throughout the screening process. The BTS should also have appropriate, validated systems for linking all test results to the correct donations and donors so that donors' records can be reviewed each time they come to donate. These systems will ensure that the correct results are allocated to each donation and prevent errors resulting in the transfusion of an unsafe unit [2].

Laboratory staff should always adhere to the national screening strategy, algorithm and standardized procedures when conducting the tests and analyzing the results. The performance of laboratory tests in a quality environment with competent staff and a functional documentation system will minimize the risk of analytical and transcription errors, particularly false negative results [3].

The objective of blood screening is to detect markers of infection in order to prevent the release of infected blood and blood components for clinical use. Blood screening strategies are designed to assure the safety of blood units, but should not be used for notifying blood donors of reactive test results. The appropriate confirmatory testing strategy for blood donor management should be applied before notifying donors of their infectivity status. The results of all tests performed for infection markers for TTIs and blood group serology should be evaluated when making final decisions on the release of blood units for therapeutic use. Donors are typically required to give consent for the process and this requirement means minors cannot donate without permission from a parent or guardian, in some countries, answers are associated with the donor's blood, but not name, to provide anonymity; in others, such as the United States, names are kept to create lists of ineligible donors [4]. If a potential donor does not meet these criteria, they are 'deferred'. This term is used because many donors who are ineligible may be allowed to donate later. Blood banks in the United States may be required to label the blood if it is from a therapeutic donor, so some do not accept donations from donors with any blood disease [5]. Others, such as the Australian Red Cross Blood Service, may accept blood from donors with haemochromatosis. It is a genetic disorder that does not affect the safety of the blood [6]. The donor's race or ethnic background is sometimes important since certain blood types, especially rare ones, are more common in certain ethnic groups [7].

Primary Aim of Donor Screening

To promote successful transplantation and safeguard the health of each recipient, the risk of disease transmission through organ transplantation must be minimized. The potential donor's medical and social history is carefully assessed to determine medical suitability by thoroughly reviewing their hospital medical records, diagnostics.

To protect the recipients of donor sperm, egg and embryos from acquiring an infection from the donor.

To promote any donor-conceived people from being born with an infection or acquiring a serious heritable disorder from the donor.

Types of Donor

Blood donations are divided into groups based on who will receive the collected blood [7]. An 'allogeneic' (also called 'homologous') donation is when a donor gives blood for storage at a blood bank for transfusion

to an unknown recipient. A 'directed' donation is when a person, often a family member, donates blood for transfusion to a specific individual [8]. Directed donations are relatively rare when an established supply exists (Wales *et al.,* 2005). A 'replacement donor' donation is a hybrid of the two and is common in developing countries such as Ghana (Brown, 1998). In this case, a friend or family member of the recipient donates blood to replace the stored blood used in a transfusion, ensuring a consistent supply. When a person has blood stored that will be transfused back to the donor at a later date, usually after surgery, that is called an 'autologous' donation. Blood that is used to make medications can be made from allogeneic donations or from donations exclusively used for manufacturing. Blood is sometimes collected using methods for therapeutic phlebotomy, similar to the ancient practice of bloodletting, which is used to treat conditions such as hereditary hemochromatosis or polycythemia Vera. This blood is sometimes treated as a blood donation, but may be immediately discarded if it cannot be used for transfusion or further manufacturing. The actual process varies according to the laws of the country, and recommendations to donors vary according to the collecting organization [9]. The World Health Organization gives recommendations for blood donation policies, but in developing countries many of these are not followed. For example, the testing requires laboratory facilities, trained staff, and specialized reagents, all of which may not be available or too expensive in developing countries [10].

Pooling for Serological Assays

The pooling of samples before testing has been the subject of debate for some years. It has been considered to be a cost-saving measure, but any cost savings have to be balanced against the risk of failing to detect a positive donation [3]. This is likely in some assays where sensitivity is compromised in diluted sample. In a pooled sample each individual sample is diluted. There is also a high risk of errors being made as a result of poor quality procedures during the preparation of the pool and when recording individual samples in each pool. An additional complication is the resolution of pools that test positive and the subsequent delay in releasing the units that comprise the pool. The pooling of samples for serology testing is therefore not recommended for a blood screening programme [11].

Sequential Screening

Blood transfusion services routinely screen for TTI markers (HIV antigen-antibody, HBsAg, anti-HCV and syphilis) at the same time [12]. The main reason for this is to reduce the time needed for screening so that the blood or blood components, especially labile components such as platelets, can be released in a timely manner. Initially reactive donations are segregated and quarantined. Depending on the algorithm used by the laboratory, the donation is then either discarded or repeat testing is performed. Some laboratories may use sequential screening by initially testing for one or two infection markers. If a reactive result is obtained, no further testing is performed on this donation. The screening strategy for determining the test or tests that are undertaken first will be influenced by the prevalence of infections in the blood donor population. Sequential screening is sometimes used in countries where the prevalence of one TTI is higher than others; for instance, HBsAg might be screened for first when the prevalence of hepatitis B is than the prevalence of HIV and HCV. In this situation, only HBsAg negative donations would then be tested for HIV antigen-antibody, anti-HCV and syphilis. No tests for these viral markers would be performed on the donations that test reactive on the HBsAg screening test. Thus there is potential for cost savings, especially if the more expensive assays do not need to be performed on donations that have already tested positive for HBsAg [11].

Blood Screening and Diagnostic Testing

In general, there is no difference between screening and diagnostic assays themselves; the differences lie in the reasons for the testing, the population being tested, the interpretation of the results and the subsequent actions. The screening algorithms used and the focus of quality systems may also differ as blood screening is product-related and diagnostic testing is not. Microbiological screening of blood is performed on donations from apparently healthy, asymptomatic donors to rule out the presence of infections and assure safe blood for transfusion. Diagnostic testing is performed as part of a clinical investigation to pursue a diagnosis of infection either as a result of signs and symptoms in an individual or a specific or identifiable risk of infection. Blood screening involves a single test with the resultant action, such as the release or discard of the donation arising from that single test alone, even though an initially reactive result may be followed by repeat testing. Diagnostic testing often involves additional testing over a period of time either to pursue the diagnosis in early infections or to follow-up or monitor infection (WHO, 2010). A single test result alone is not relied upon to determine infection or subsequent actions. Diagnostic samples are high-risk samples as they are generally taken from symptomatic patients; they should not be mixed with blood samples from blood donors. In hospital-based blood services, diagnostic testing facilities should be separate from those used for blood screening.

Assessment Needed for a Potential Donor

• Complete head-to-toe physical examination for observation of: tattoos, piercings, and evidence of needle tracks, discoloration or sores on mucous membranes, swollen lymph nodes, masses.

• Arterial blood pressure (ABP), central venous pressure (CVP), heart rate, temperature, urine output.

• Height, weight, abdominal girth.

• Ventilator settings.

• Documentation of sedation received.

• BP support (e.g. inotropes, vasopressors, and antihypertensive).

• Intravenous (IV) fluids (type and rate).

• Other IV medications (type, dose and rate).

• Known allergies

Basic Donor Testing

The following are tested and checked if normal and these are:

• ABO - Blood Group (Cross and Type)

• Arterial Blood Gases (ABGs)

• CBC

• CK, Troponin (I or T) q6-8h

• Urinalysis q24h

• Toxicology screen (blood or urine) unless overdose ruled out by MD

• C & S - sputum, urine and blood (include gram stain) q24h

• 12 lead EKG

• CXR - with interpretation/report

• Levels of serum electrolytes, creatinine

• Liver profile - Bilirubin (total and direct), AST, ALT, ALP, LDH, Total Protein, Albumin, GGT, PT/INR, PTT q4-6h

• Renal profile -Urea, Glucose, Ca, PO_4, Mg, Lactate q4-6h

• Pancreas profile - Blood sugar, amylase or lipase

Additional Testing Needed for Heart and Lung Assessment

• Bronchoscopy is considered for all potential lung donors. A second bronchoscopy will be performed in the Operating Room (OR) if the lungs are accepted for recovery.

• Echo - include assessment of left ventricular (LV) function/ejection fraction (EF), valve function, description of wall motion and function, evaluation of heart function.

• Coronary angiography may be requested by the transplant surgeon depending on age, risk factors and ECHO results of the potential donor.

• ECG - Electrocardiogram for heart

To Determine Tissue Matching Between Donor and Recipient

ABO and histocompatibility also referred to as HLA testing (Human Leukocyte Antigen) or tissue typing, is completed. This testing detects antigens (genetic markers) on white blood cells and is used to assess tissue compatibility between the donor and potential recipients. HLA is a critical factor in determining which patient is selected to receive a donated organ and reduce the potential for rejections after transplantation. All the blood tubes needed for tissue typing is in the Red Box.

To Test for Infectious Diseases

To minimize the risk of disease transmission through organ donation, the donor's blood is carefully screened for the presence of transmissible diseases. The information is used to help determine the medical suitability of organs. All the blood tubes for infectious diseases are in the Red Box.

According to the Health Canada Guidance Regulations, minimum serological testing for infectious diseases includes the following:

• HIV-1, HIV-2 (Human immunodeficiency virus antibody)

- HTLV-1, HTLV-2 (Human T-cell lymphotropic virus)
- HBsAg (Hepatitis B surface antigen)
- Total anti-HBc (Hepatitis B core antibody)
- HCV (Hepatitis C virus antibody)
- Syphilis
- West Nile Virus (seasonal)
- Toxoplasmosis for heart donors
- Cytomegalovirus (Anti CMV IgG) (total antibody to CMV)
- *Epstein-Barr virus* (Anti EBV IgG) (antibody to EBV)

To address the possible transmission of infectious agents in donors under 18 months of age or up to 12 months beyond breast-feeding, the serology of the birth mother is also tested. The results of infectious diseases are needed prior to organ transplantation (CMV, EBV may be reported retrospectively).

Conclusion

Blood is special to every human being for vitality of life. Blood transfusion is paramount in saving lives especially when it is necessary. Life is so precious and should be handled with care. Safe blood transfusion is a major concern in transfusion medicine. Safe blood transfusion starts with proper selection of donor. Voluntary donors should be encouraged unlike the commercial donors who have greater risks of transmissible transfusion diseases and other related risks because of unhealthy life style and quest for money. All the necessary steps should be careful followed to achieve the aim of having safe blood for transfusion. A correct, safe and compatible blood giving to a patient that needs it will add value to life and fulfillment to the society. Blood donation sensitization should be regularly carried out to motivate many donors.

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