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COMPATIBILITY ISSUES IN BLOOD TRANSFUSION

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Abstract:

Pre-transfusion testing refers to the laboratory testing required to ensure compatibility between the blood of the transfusion recipient and the blood product intended for transfusion. This procedure encompasses proper completion of the requisition, proper patient identification, collection and labelling of the blood sample from the patient, laboratory testing to determine the recipient patient's blood group and to identify the presence of red blood cell alloantibodies, and compatibility testing before going for actual transfusion. Pre-transfusion testing is completed when a compatible blood product is identified for transfusion to the intended recipient. A blood transfusion is a routine medical procedure in which donated blood is provided to the patient needing it. This potentially life-saving procedure can help replace blood lost due to surgery or injury. Blood transfusions usually occur without complications. When complications do occur, they're typically mild. It is essential that hospitals and clinics collecting samples for pre-transfusion testing have a specific policy and procedure for positive patient identification and appropriate labelling of pre-transfusion test samples. There are various considerations which need to be understood before going for transfusion. Compatibility issues form the main issue before going for transfusion. In this paper, we will briefly look at the various pre-transfusion considerations.

Key words: *Blood, Antibody, Transfusion testing.*

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INTRODUCTION:

Blood transfusion has certain risks, and any unfavorable event occurring in a patient during or after transfusion, for which no other reason can be found, is called a transfusion reaction. These adverse effects vary from being relatively mild to severe and need rapid identification and management. Transfusion medicine is based on transfusion reaction reporting to give patient care and protect the blood supply. Unnecessary discontinuation of blood is a major wastage of scarce blood, as well as man, hours, and funds. In spite of strict procedures are employed during blood donation preparations and transfusions, errors in transfusion and infection complications still pose a threat in clinical practice [1]. It is essential that hospitals and clinics collecting samples for pre-transfusion testing have a specific policy and procedure for positive patient identification and appropriate labelling of pre-transfusion test samples. The first step in pre-transfusion testing is the preparation of the testing requisition. Patient identification should be verified at this time. The second step is to ensure the blood sample is collected from the intended transfusion recipient [2-4]. Samples must be properly and uniformly labelled with two unique identifiers. Unique identifiers use first and last name and most commonly, either the hospital number or provincial health insurance number. The samples must be labelled immediately following collection in the presence of the patient. Some standards require the date of collection on the tube and all require a method to identify the phlebotomist [2-4]. Patients should be asked to state their first and last name and date of birth since they may be wearing the wrong identification bracelet [5].

The goal of pre-transfusion compatibility testing is to provide the patient with a beneficial and safe transfusion [6]. Pre-transfusion compatibility testing is a series of testing procedures and processes with the ultimate objective of ensuring the best possible results of a blood transfusion [7]. Pre-transfusion and perinatal blood testing is performed to prevent transfusion reactions and hemolytic disease of the fetus and newborn, and must include the key serologic evaluation of ABO and Rh antigen typing, antibody detection / identification and cross matching. A consensus on pre-transfusion compatibility testing procedures and processes is as follows:

Table 1 Consensus PRE-TXN Practices, 2001 [8].

- ABO Testing
  Tube method using monoclonal reagents
  Patient sample ≤3 days old if, within past 3 months, patient has been
    Pregnant
    Transfused
- Rh testing
  Tube method using monoclonal/polyclonal blend reagent
  Patient sample ≤3 days old if, within past 3 months, patient has been
    Pregnant
    Transfused
- Historical record check
  Every patient, every time
- Screening for unexpected alloantibodies
  Tube method using three vial sets (not pooled) of reagent RBCs and LISS enhancement media; PEG enhancement media on the increase
  Gel method on the increase
  Detect clinically significant alloantibodies reactive at 37°C
  Although not required, most labs still read for hemolysis and agglutination before and after addition of AHG; only a reading after addition of AHG is required
  DAT and autocontrol are not required
- Alloantibody identification
  Tube method with LISS enhancement media
  Gel method on the increase
  Additional methods may be useful:
    Prewarm serum
    Increase serum-to-cell ratio
    Enzyme-treated reagent RBCs
    PEG
- Management of previously identified alloantibodies
  Honor all clinically significant alloantibodies, even if currently undetectable
  It is not necessary to reidentify previously identified alloantibodies
- Crossmatch
  Serologic
    Use immediate spin only if
      No alloantibody has been currently or historically identified
    Use AHG crossmatch if
      An alloantibody has been currently or historically identified
  Electronic
    Use only when immediate spin crossmatch would have been used

Strict adherence to and application of each parameter of pretransfusion compatibility testing is imperative to the management of safe blood transfusion therapy.

Antibody Detection :

Antibody detection plays a critical role in transfusion medicine. It is a key process in pre-transfusion compatibility testing. It aids in the detection and monitoring of patients who are at risk of delivering infants with hemolytic disease of the newborn (HDN). It is one of the principle tools for investigating potential hemolytic anemia. The focus of antibody detection methods is on "irregular" or "unexpected" antibodies as opposed to the "expected" antibodies of the ABO system. These unexpected antibodies may be immune alloantibodies, produced in response to RBC stimulation through transfusion, transplantation or pregnancy. Other unexpected antibodies may be "naturally occurring", produced without RBC stimulation. Naturally occurring antibodies may form as a result of exposure to environmental sources, such as pollen, fungus and bacteria, which may have structures similar to some RBC antigens. Another category of antibody is the passively acquired antibody. Passively acquired antibodies are produced in another individual and then transmitted to the patient through plasma-containing blood products or derivatives such as intravenous immunoglobulin (IVIG). Of greatest concern are the unexpected antibodies that cause decreased survival of RBCs that posses the target antigen. These antibodies are deemed "Clinically Significant". Clinically significant antibodies are usually IgG antibodies that react at 37^0C or in the Antihuman Globulin (AHG) phase of the indirect antiglobulin test and are known to have caused a transfusion reaction or unexpectedly short survival of transfused RBCs [9].

Table 2 Clinical significance of 37^0 C. Reactive Antibodies [10].

Usually*	**Very Unusual(if ever)+**	**Sometimes**
ABO	Bg(HLA)	Cartwright (e.g.,Yt^a)#
Rh	Ch/Rg(Complement C4)	Lutheran (e.g., Lu^b)#
Kell	Le^b	Gerbich#
Duffy	JMH	Dombrock#
S,s,U	Xg^a	M,N#
P		Le^a
		Vel
		LW
		Ii
		H
		At^a
		In^b
		Mi^a
		Cs^a

* These antibodies usually cause obvious clinical symptoms and decreased RBC survival. Sometimes no obvious clinical symptoms occur.

+ These antibodies rarely (if ever) cause clinically obvious symptoms, but there are some data to suggest that some unusual examples of Bg, anti-Kn/Mc/Yk, and JMH cause shortened RBC survival.

These antibodies rarely cause acute severe HTR, but when they are " clinically significant " they may cause obvious clinical symptoms (e.g., jaundice); they more often cause only shortened RBC survival.

Autoantibodies complicate the detection of clinically significant antibodies. Autoantibodies are directed at antigens expressed on one's own RBCs. Because they react with all cells tested, autoantibodies may mask the presence of clinically significant alloantibodies. The incidence of unexpected alloantibodies depends on the fact the antibody formation is the result of exposure to a foreign RBC antigen and the patient's ability to respond to that exposure. This occurs by allogenic transfusion of RBCs, pregnancy or transplantation. The incidence of unexpected antibodies in the general patient population, therefore, is low 1.64 in one large study and 0.78 percent in another. It follows, then, that the more frequently a patient is exposed to foreign RBC antigens, the more likely that patient will produce unexpected alloantibodies. This is evidenced by a study of multiply transfused sickle cell patients in which 29 percent of pediatric and 47 percent of adult multiply transfused sickle cell patients developed clinically significant alloantibodies [11].

Table 3 Alloimmunization risk in various disease [12]:

Disease	**Number of Patients per study**		**Immunization risk**	
	Range	**Total**	**Range**	**Median**
SCD	34-1044	3409	9.9-46.8	30.0
Children	42-245	596	7.8-29.5	18.5
Thalassemia	39-1434	3424	5.0-28.4	9.7
Hematologic				
Myelodysplastic syndrome and Chronic myeloproliferetive disease	16-112	231	125-58.6	23.2
Myeloid leukemia	35-209	244	5.7-8.6	7.5
Lymphoid leukemia	13-193	206	0.0-0.5	0.3
Renal failure	81-405	1296	1.1-14.0	5.9
Transplantation Organ	35-1132	3007	2.7-9.0	6.2
Hematopoietic stem cell	117-217	885	1.3-9.1	2.3
AIDS	72-81	153	1.4-3.7	2.6

Surgery	374-530	1356	2.1-8.0	5.3

Detection of unexpected antibodies is important for the section of donor RBCs that will have the best survival rate in the patient's circulation and reduce the risk of hemolytic transfusion reaction. Antibody screening tests should demonstrate the presence of all potentially clinically significant alloantibodies in the recipient's serum / plasma and indicate the need for further studies. All antibodies encountered in the screening test must be identified to determine potential clinical significance and to allow a logical decision to be made whether there is a need to select antigen- negative units for transfusion [13].

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