

Division of Blood Transfusion Services

Ministry of Health and Family Welfare



Basics of Transfusion transmissible Infection

Teaching Aim

To help participants to understand the basics of TTI

Definition

The microbial agents of importance in blood transfusion services are those organisms that are transmissible by blood and can cause morbidity and mortality in recipients.

Characteristics of TTI

- Cause mild or asymptomatic infections such that infected potential donor would be accepted for donation.
- If symptomatic, would have a long incubation period eg. months (HBV, HCV) or even years (HIV) prior to development of symptoms.
- Might cause a “carrier state” of infection (HBV, HCV)

Organisms transmitted by Blood

- Hepatitis B virus (HBV)
- Hepatitis C virus (HCV)
- Hepatitis D virus (HDV)
- Human Immunodeficiency Virus (HIV)
- Cytomegalovirus (CMV)
- Epstein Barr Virus (EBV)
- Parvovirus B 19
- Malaria
- Babesia
- Trypanosomacruzi
- Leishmania
- Toxoplasma gondi
- Microfilaria
- HTLV I and II

Human Immunodeficiency Virus

- HIV is a retrovirus, an enveloped RNA virus, which is transmissible by the parenteral route. It is found in blood and other body fluids.
- Once in the bloodstream, the virus primarily infects and replicates in lymphocytes. The viral nucleic acid persists by integrating into the host cell DNA.
- HIV-1 group M is responsible for more than 99% of the infections worldwide. The prevalence of HIV-2 is mainly restricted to countries in West Africa.
- The appearance of antibody marks the onset and persistence of infection, but not immunity.

Human Immunodeficiency Virus (contd...)

- As HIV can be present in the bloodstream in high concentrations and is stable at the temperatures at which blood and components are stored, the virus may be present in any donated blood from an HIV-infected individual.
- Infectivity estimates for the transfusion of infected blood products are much higher (around 95%) than for other modes of HIV transmission owing to the much larger viral dose per exposure than for other routes.

Hepatitis B Virus

- It is a member of the hepadena virus group and is an enveloped DNA virus.
- HBV is transmissible by the parenteral route and may be found in blood and other body fluids. From the bloodstream, the virus travels to the liver where it replicates in hepatocytes. HBV is highly prevalent in certain parts of the world such as the Far East and Africa(AABB).
- The viral DNA is normally present in the recently infected person, although not always at high levels.
- Chronically infected individuals may either be infectious (viral DNA present) or non-infectious with HBV,

Hepatitis B Virus (contd...)

- The distinction between acute and chronic infection is not relevant to blood screening.
- All HBsAg positive donations should be considered to be at high risk of transmitting HBV and should not be released for transfusion.
- The serology of HBV is complex. A number of different serological markers develop during the course of infection, including hepatitis B surface antigen (HBsAg) and hepatitis B core antibody (anti-HBc).
- In addition, HBV DNA can be detected in the majority of cases, although in HBsAg negative phases of infection, the DNA levels are generally relatively low and the viraemia may be transient.

Hepatitis B Virus (contd...)

- Hepatitis B surface antigen is the prime marker used in blood screening programs. It normally appears within three weeks after the first appearance of HBV DNA and their levels rise rapidly.
- The presence of HBsAg may indicate current or chronic infection and thus potential infectivity.
- Most blood transfusion services screen donated blood for HBsAg using sensitive immunoassays.

Hepatitis C Virus

- Hepatitis C virus (HCV) is a member of the flavi virus group and is an enveloped RNA virus.
- It is transmissible by the parenteral route and may be found in blood and other body fluids.
- Once in the bloodstream, the virus travels to the liver where it replicates in hepatocytes, resulting in a similar picture to that seen with HBV infection.

Hepatitis C Virus (contd...)

- In recently infected individuals, virus is normally present.
- Screening for both HCV antigen and antibody does not in itself distinguish between recent and chronic infection.
- All HCV antigen-antibody reactive donations should be considered to be at high risk of transmission of HCV and should not be used for clinical use.

Syphilis

- Syphilis is caused by the bacterium *Treponema pallidum*.
- It is transmissible by the parenteral route and may be found in blood and other body fluids.
- When it enters in to the bloodstream, the bacteria spreads throughout the body.
- Although the duration may be shorter in cases of transfusion-transmitted infection where the organism enters the bloodstream directly.

Syphilis (contd...)

- Syphilis is endemic in many parts of the world
- The treponemes are relatively fragile, in particular being heat-sensitive, storage below +20°C for more than 72 hours results in irreparable damage to the organism such that it is no longer infectious.
- Thus, although clearly potentially infectious, the risk of transmission through blood and blood components stored below +20°C is very low.
- Blood components stored at higher temperatures (above +20°C), such as platelet concentrates, present a significantly higher risk of transmitting syphilis.

Malaria

- Malaria is caused by parasites of the *Plasmodium* species.
- There are four main types that infect humans: *P. falciparum*, *P. vivax*, *P. malaria* and *P. ovale*.
- Malaria is primarily transmitted to humans through the bite of the female *Anopheles* mosquito.

Malaria

- Although primarily transmitted by mosquitoes, malaria is readily transmitted by blood transfusion through donations collected from asymptomatic, parasitaemic donors.
- parasite is released into the bloodstream during its lifecycle and will therefore be present in blood donated by infected individuals.
- The parasites are stable in plasma and whole blood and viable for few days when stored at +4°C.

Residual risk of transfusion - transmissible infections

- Despite various measures taken to protect blood supply, there still exists residual risk for transmission of pathogens after screening. This is due to following reasons:
- Window period of donation
- Absence of sero-conversion
- Genetic variability in the virus strain
- Laboratory errors

Window period of donation

- The window period is the time interval between the donor becoming infectious and the infection being detected by a laboratory test.
- During this period, the particular screening marker is not yet detectable in a recently infected individual, even though the individual may be infectious.
- This period is dependent upon the type of lab test used: in general antibody appears only after viral antigens are detectable in the blood.
- Nucleic acid, as part of the native infectious agent itself, is the first detectable target to appear, followed within a few days by antigen, and subsequently by antibody as the immune response develops.

Window period of donation (contd...)

- One or a combination of markers of infection can be used to detect a particular infection during the screening process.
Various assay systems developed for blood screening detect:
- Antibodies that indicate an immune response to the infectious agent
- Antigens that are produced by the infectious agent and indicate the presence of that agent
- Nucleic acid (RNA/DNA) of the infectious agent.

Blood screening process

- 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 use or be discarded.
- Laboratory screening for TTIs should be performed on blood samples collected at the time of donation.

Blood screening process (contd...)

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

Pre Donation screening

- All screening of blood donations for TTIs should be carried out only on samples taken during the donation process.
- The testing of blood donors for TTIs before they donate blood (pre-donation testing) is the subject of debate.
- It is sometimes considered to be a cost-saving measure, particularly in high-prevalence situations.

Transfusion associated Bacterial sepsis

- Septic transfusion reactions with the use of contaminated blood products remain a very significant adverse effect.
- Bacterial sepsis is considered the second most common cause of transfusion related mortality after ABO incompatibility
- The prevalence of bacterial contamination in random platelet concentrates is significantly higher than in single donor platelets.

The possible sources for bacterial contamination of blood products include :

- Donor bacteremia,
- Contamination of the collection bag,
- Contamination during blood processing procedures

Preventive strategies for bacterial contamination

- Improved venipuncture site disinfection
- Removal of first aliquot of the donor blood by using bags with diversion pouch.
- Optimizing storage temperature
- Visual inspection of component before use

Preventive strategies for TTI

A variety of strategies have evolved in recent years in an attempt to decrease the morbidity and mortality associated with TTI.

They are summarized in the following steps:

Preventive strategies for TTI (contd...)

- **Careful donor selection.**
 - Repeat voluntary blood donors
 - Education counselling and retention of these donors
 - Improvement in the blood donor screening criteria
- **Universal leukocyte reduction**

Preventive strategies for TTI (contd...)

- **Improved pre- transfusion blood testing**
 - Sensitive and specific serological testing
 - Addition of newer methodologies/ better proven kits - added
- **Reducing recipient exposure to blood donor**
 - Optimizing transfusion indications
 - Increased use of single donor products
- **Pathogen inactivation**

Learning Outcome

Enabled knowledge on basics of TTI