AN OVERVIEW ON BLOOD DONORS MEDICAL HISTORY AND RISK OF DISEASES TRANSMISSION: WITH SPECIAL REFERENCE TO EGYPT
By

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Abstract

A blood transfusion provides blood or blood components to a save patient life who lost blood due to an injury, during surgery or have certain medical conditions that affect blood or its components. Before transfusion, a nurse must check blood pressure, pulse and temperature, make sure the donor blood type is a match for patient blood type and make sure that the supplied blood is the product ordered by your doctor and is labeled with patient name. During transfusion, she must recheck blood pressure and pulse after 15 minutes, and recheck patient blood pressure and pulse at the transfusion end. But, viruses, parasites and specific bacteria can be transmitted in donated blood through a transfusion to the recipient. This reviewed the commonest infectious diseases to prevent spread of such diseases by blood transfusion.

Key words: Blood transfusion, Donor screening, Viruses, Parasites, Bacteria, Laboratory tests

Introduction

A major goal of transfusion medicine practice was to reduce the risk of transfusion-transmitted infection to as low a level as possible (AuBuchon *et al,* 1997).

Rationale: Donor screening and laboratory testing of donated blood prior to transfusion are intended to ensure that recipients receive the safest possible blood products. As of 2009, such testing consists of determining the ABO blood group and Rh blood type of the donated unit, testing for red cell antibodies, and performing infectious disease screening for the following agents: HIV-1, HIV-2, human T-lymphotropic virus (HTLV)-I, HTLV-II, hepatitis C virus, hepatitis B virus, West Nile Virus (WNV), and *T. pallidum* (syphilis). Also, blood collection agencies must be screened for antibody to *Trypanosoma cruzi*, toxoplasmosis (Sarwat *et al,* 1993), visceral leishmaniasis, malaria (Saleh *et al,* 2016) and brucellosis causative agents. Standard serological testing of donated blood for the human immunodeficiency virus (HIV) and hepatitis C virus (HCV) has been supplemented by the addition of nucleic acid testing of pools of donations for HIV & HCV RNA, which allowed detection of more infectious units (Stramer *et al,* 2000).

Risk of viral infection from transfusion: Current per unit risk estimate for acquiring HIV from transfusion is one in 1.5 to 2.1 million, and for HCV is one in 1.1 to 1.9 million (Zou *et al,* 2010). Risks for hepatitis B virus (HBV) are more difficult to determine, since there are more unknowns in the mathematical model; current estimates range from one in 205,000 to one in 355,000, and were lower than the mid-1990s estimate of one in 63,000 (Schreiber *et al,* 1996). The risk for HTLV was estimated to be about one in two million when the older published risk estimate (one in 641,000) was adjusted for the fact that only one-third of potentially infectious units actually transmit HTLV infection, due to loss of viable virus upon blood component storage (Zou *et al,* 2009).

Donor Screening: Major procedure to screen blood-donors at the donation site are the medical history interview, which contains questions to protect the recipient from acquiring a transfusion transmitted infection and to protect donor from suffering an adverse reaction after donation. To exclude donors

with bacteremic, viremic, or parasitemic, blood was not collected from febrile persons at time of blood donation, or who stated that they didn't feel well, or who on the systemic antibiotics (Kleinman, 1996).

In 1983, with the recognition of the possible transmission of HIV by transfusion, the health history interview assumed new importance and became more complex and probing than it had previously been. Trend of adding medically sophisticated questions and / or socially sensitive behavioral questions to donor interview continued up to-day. They were asked questions concerning their sexual activities, injection drug use history, prior HIV testing history, and history of selected sexually transmitted diseases. Donors are also queried concerning exposure to or medical history of Hepatitis, Malaria, CJD, Babesiosis, Leishmaniasis Chagas disease and others blood-borne pathogens (WHO, 2012).

A distinct decline was documented in the prevalence of hepatitis C virus and HIV infection in blood donors between the years 1991-1992 and 1996 (Glynn *et al*, 2000). A second study done by the American Red Cross gave similar data, establishing that prevalence of hepatitis C, hepatitis B, & HIV infection declined in blood donors from 1995 to 2002 (Zou *et al*, 2004). A Canadian study extended these HCV findings to 2006 and a US study extended HBV findings to 2008. Although many factors may explain the decreases, possible reasons for this decline include (O'Brien *et al*, 2008): a- Effectiveness of behavioral risk factor screening, b- In the past, HCV-positive donations occurred frequently in donors born between 1945 & 1964; currently, most first-time donors were born after 1964, c- About 2/3 of HCV-positive Canadians in the general population were tested for HCV, and were likely to self- defer from donating blood, and d-Increasing hepatitis B vaccination rates in younger donors.

Medical history questions concerning specific risk factors for infectious disease need to meet the deferral criteria established by the FDA recommendations. Also, each blood center's medical history standard operating procedure must be approved by the FDA. Variation between blood centers in the exact wording of questions or in the format of interviewing blood donors is permitted. An interagency task force under the AABB auspices (formerly American Association of Blood Banks) has reworded the donor questions for increased clarity and has validated these newer questions through cognitively based research protocols. This uniform donor history questionnaire (UDHQ) was approved by and was used by many blood centers (FDA, 2011). It can be administered orally or can be self-administered, with follow-up questioning by a health historian if donor's responses raise questions about donor eligibility. Besides, several blood centers have implemented a computer-assisted self-interviewing (CASI) process that includes audio, pictorial (visual), and touch screen components. A two-year evaluation at one blood center showed that identification of high risk behaviors among prospective first time donors significantly increased following the use of CASI when compared with results obtained from the previously administered oral questionnaire (Katz *et al,* 2005).

Vaccination: AABB standards for donors who have been vaccinated are as follows (FDA, 2011): a- No deferral for donors who are asymptomatic after receiving toxoids, synthetic, or killed vaccines, b- A two-week deferral for receipt of certain live or attenuated viral or bacterial vaccines (measles, mumps, oral polio, oral typhoid, yellow fever), c- A four-week deferral for receipt of rubella or varicella zoster vaccines, & d- One-year deferral for receipt of unlicensed vaccines, unless a shorter timeframe is approved by the facility's medical director. When the possibility of smallpox vaccination of segments of the US population arose, additional deferral questions were added to donor history to address recent receipt of a smallpox vaccination and skin contact with someone who was recently vaccinated. Positive responses lead to temporary deferrals (minimum

of three weeks) to ensure that the donor is beyond the period of viremia (FDA, 2002). Importance of vaccine-related deferrals was illustrated by the occurrence of transfusion-related transmission of yellow fever vaccine virus from donors in whom a proper vaccine history was not obtained (CDC, 2010b).

Human Immunodeficiency Virus (HIV): FDA (1992) issued a set of recommendations for screening prospective donors for prevention of HIV transmission, which stated that prospective donors: a- Must receive both oral and written information concerning HIV (AIDS) risk factors and the potential for HIV transmission through the donated blood. This information should include informing the donor that, in early HIV infection, a donor may be infectious and capable of transmitting HIV despite having a negative test for HIV antibody, b- Should be given specific information as to how they can obtain an HIV antibody test at a site other than the donor center, c- Must be told that all units of donated blood will be HIV antibody tested and, if positive, donor will be notified of the result and his/her name will be placed on a donor deferral registry, d-Must be advised not to donate if symptoms that may be compatible with HIV infection are present. Symptoms include persistent fevers, night sweats, unexplained weight loss, persistent cough or shortness of breath, persistent diarrhea, swollen lymph nodes that persist for < month, presence of whitish oral lesions, or presence of bluish purple spots on the skin or in mouth, and e-Should be asked direct health history questions about behaviors that placed them at risk for HIV. Preferably such questions should be asked orally.

In Egypt, Boutros and Skordis (2010) reported that by international standards, HIV/AIDS prevalence was < 0.1%. They added that this figure was coupled with fears of an imminent increase in prevalence, with evidence suggesting that, despite Egypt's conservative culture, high-risk behavior was more widespread than commonly reported and the changing socioeconomic context perpetuated

this trend. Donors must sign a consent form that specifically states that they understand that they should not donate blood if they are at risk for HIV infection.

Deferral of donors: Specific information to be obtained from donors during the donor interview that led to a permanent deferral as a blood donor includes: 1- Do you ever had clinical or laboratory evidence of AIDS or HIV infection? 2- For men: Do you had sex with another man, even once since 1977? 3- Do you ever injected IV drugs? 4- Do you engaged in sex in exchange for money or drugs since 1977? & 5- Do you received clotting factor concentrates for hemophilia or other clotting disorders?

Donor should also be asked questions regarding behaviors during the last 12-months interval; a yes answer to any of these questions lead to a temporary deferral that is removed 12 months after the last potential exposure. Donor must be asked if he or she has had sex in past 12 months with: 1- A person who has HIV infection or AIDS, 2- A prostitute, 3- A person who currently or previously used IV drugs, 4- For women: A man who has had sex with another man, and 5- A person receiving clotting factor concentrates

Donor should also be asked if, in the last 12 months, he/she has had or has been treated for syphilis or gonorrhea, received a blood transfusion, experienced an accidental needle-stick injury or a blood splash to a mucous membrane or non-intact skin, or received a skin or bone graft or a tissue or organ transplant. Questions about blood or tissue exposures are designed to protect the recipients not only against HIV, also against other transfusion-transmitted agents.

Two additional changes to HIV screening procedures were implemented since the comprehensive recommendations in 1992. The FDA (1995) recommended that persons who were inmates of correctional institutions and individuals who have been incarcerated for more than 72 consecutive hours during last 12 months be deferred for 12 months from their last date of incarceration (FDA, 1995).

New direct questions on high risk behavior be added in order to exclude donors who are at increased risk for HIV-1 group O infection (FDA, 1996). These questions relate to birth in Cameroon or surrounding West African countries where HIV-1 group O infection has been identified, to blood transfusion or medical treatment received in those countries, and to sexual contact with anyone who was born in or lived in those countries since 1977. This latter set of questions were only required for those blood centers that didn't switched the HIV screening assay to a test version that was higher sensitivity for HIV-1 group O strains (Sheppard *et al,* 1991).

A preponderance of data has demonstrated that the theoretical possibility of long-term persistent HIV infection without detectable HIV antibody, HIV antigen, or clinical symptoms not existed or was exceedingly rare (Jackson, 1992). Multiple studies demonstrated that HIV nucleic acid cannot be detected in HIV antibody-negative persons from high risk groups at risk for latent HIV infection (Busch and Satten, 1997). Seroconversion for HIV highly likely occurred within six months of HIV exposure; studies in health care workers exposed to HIV infected blood by needle-stick injury, longest interval from exposure to HIV seroconversion was 213 days (Ridzon *et al,* 1997). Since these studies, improvements in HIV screening assays showed that interval to sero-conversion was shortened (Lindbäck *et al,* 2000). So, HIV risk behaviors that can be defined as ending at a specific point in time (e.g., sex with a particular person who demonstrated HIV risk behaviors, an accidental exposure to blood, or blood transfusion) must only defer a prospective donor until laboratory testing can definitively prove that the individual is free of HIV infection. Although the scientific data indicate that this is only a matter of a few months, given the combination of HIV nucleic acid testing and serologic screening, the deferral period for these risk behaviors has been conservatively set by the FDA at 12 months (Germain *et al,* 2003). However,

despite this stated rationale, men who have had sex with other men (MSM), even once since 1977, were currently permanently deferred as blood donors in the United States. This requirement placed since the mid-1980s has been the subject of intense debate; risk modeling studies were performed to evaluate whether the policy can be altered to no longer defer persons with MSM activity that ceased many years ago (Anderson *et al,* 2009) However, this policy was not changed and reaffirmed by the FDA in May 2007 (FDA, 2007) and late in 2010. Other countries have deferral periods ranged from 6 months to permanent deferral (Hurley, 2011).

Evaluating donor history questions: An approach to evaluating the potential sensitivity of medical history questions has been made by mailing an anonymous survey questionaire to recent successful donors for the purpose of determining the percentage of such donors who would admit to behavioral infectious disease risk factors that they had previously denied at the donation. Investigators from the retrovirus epidemiology donor study (REDS) mailed a 53 question optical scan format questionnaire to 50,162 allogeneic blood donors who successfully donated blood within the previous 4 to 8 weeks at one of five participating REDS blood centers (Williams *et al,* 1997). Questionnaire contained items related to demographics, donation history, comprehension of written donation literature, use of confidential unit exclusion (CUE) or callback procedures, sexual history, and injection drug, other history related to HIV risk, HIV test seeking, donor's knowledge about AIDS, and about donor eligibility criteria. Questions pertaining to sexual behavior and injection drug use were preceded by a short statement explaining their purpose need for truthful answers, and giving the respondent permission to not answer any objectionable questions. Of 50,162 donors sampled, 69% responded and 98% of the respondents answered all risk questions. Data were analyzed by using sampling weights to adjust for differential sampling and/or re-

sponse rates among different demographics: 1.9% of respondents re-ported at least one behavioral risk that should have resulted in donor deferral. In 0.4%, this risk occurred in the prior three months, a time frame compatible with acute seronegative window period infection. The 1993 results were corroborated by a similar anonymous survey by the same investigators sent to 92,581 donors in 1998 (Glynn *et al*, 2001). These data showed a low level of behavioral risk that was not eliminated by donor questioning, laboratory testing, or confidential unit exclusion (CUE) and callback procedures. They support previous interview studies of HIV and HCV seropositive donors which showed that a high percentage of such donors will admit to a history of risky sexual behavior or past intravenous drug use that they had denied prior to donation (CDC, 2010a). Besides, a study of seven American Red Cross blood donor history questions indicated that there is a continuing need for improving the clarity and comprehension of the screening questions (Orton *et al*, 2000). Consequently, the continued efforts to improve sensitivity of behavioral screening appear to be warranted.

Viral Hepatitis: Federal guidelines for preventing transmitted hepatitis were established decades ago in the Code of Federal Regulations and thus revised (FDA, 1993a). The current regulations require the following deferral policies: a- Persons with a history of viral hepatitis after age 10 were permanently deferred, b- Persons currently or previously testing positive for HBsAg were permanently deferred, c- Persons with close contact history with viral hepatitis patient were deferred for 12 months after last potential exposure, and d- Persons who received a blood transfusion were deferred for 12 months.

Viral hepatitis history applies only to clinical disease; deferral is not required when donor's history was based only on a positive serologic result (i.e., anti-HBc or anti-HBs) that indicated past exposure to HBV. The lack of deferral for viral hepatitis occurring before the age of 10 is based upon epidemio-logic evidence in the United States that clinical viral hepatitis occurring in early childhood is almost exclusively due to infection with the hepatitis A virus that didn't induce a chronic status (Sherertz *et al*, 1984). Additional questions about receiving a tattoo or body piercing within the last 12 months have also been included on the donor questionnaire, due to concerns about hepatitis transmission (Goldman *et al*, 2009). But, affirmative answers didn't necessarily result in deferral. Some blood centers accept donors with body piercing, provided that the procedure was performed with sterile, single use equipment. Donors with tattoos or permanent makeup were deferred for 12 months after exposure unless the application was performed in a state that has a regulatory body that licenses tattoo parlors. In this case, donor deferral was at the discretion of the local blood collection agency. The close contact definition with a viral hepatitis person clearly includes the sexual contact but, other aspects of close contact are more problematic to define. The definition used by the UDHQ is living in same dwelling; this implies the sharing of household, kitchen, or toilet facilities. For HBV, the definition being reasonable since it was rarely transmitted from an acutely infected patient to a household contact, probably via nonsexual contact with body fluids (Perrillo *et al*, 1979). But, data didn't support similar transmission for HCV and deferral was not required for sexual or other close contact with an asymptomatic HCV carrier (Alter, 1993).

Malaria: Malaria transfusion-transmitted is common in some parts of the world but rare in the States, occurring at an estimated rate of 0.25 cases/million donated units for 1972-1988 (Guerrero *et al*, 1983), and zero to 0.18 cases/million units transfused, from 1996 to 1998, three transfusion-transmitted cases occurred with two fatal (CDC, 1999). Policies for preventing such transmissions rely on donor questioning during health history interview.

The deferral criteria for malaria risk were

revised by the FDA (2000): a- Donors with a history of malaria are deferred for three years after becoming asymptomatic, b- Travelers to a malaria endemic area are deferred for one year after returning to the States (provided they have not had malarial symptoms), & c- Immigrants from or residents of malarial endemic countries, defined as living in that country for more than five years, are deferred for three years after their departure from the endemic country based upon the premise that such individuals may have partial tolerance to malarial parasites, thereby resulting in the delay of malarial symptoms beyond one year. These policies represented a compromise between prevention of transmission and acceptable levels of donor deferral in that was well known that a *P. malariae* chronic carrier state may persist for decades, resulting in transfusion transmission many years. But, not all malaria-endemic areas pose equal risks for malaria development. Travel to Africa was estimated to present a risk for malaria infection >1000 times that of travel to endemic parts of Mexico (Spencer *et al,* 2009). FDA (1994) draft guidance document has proposed a revision of the malarial don-or screening criteria for immigrants from or residents of malarial endemic countries for at least five years. Also, a 3-year deferral after arrival in the States, these persons were deferred for three years after last visit to a malarial endemic region, due to possibility that partial acquired immunity to malaria could delay malarial symptoms. In a retrospective study of transfusion-transmitted malaria in the States from 1963 to 1999, there were 93 cases reported to the CDC; 10 of the 93 patients died (Mungai *et al,* 2001). Among the donors for whom complete information was available, 62% were excluded from donating according to current guidelines or those in place at the time of donation. Apart from blood transfusion, nosocomial infection by contaminated gloves (Piro et al, 2001) and needle-stick injury (Abdel Motagaly *et al,* 2017) were reported.

In Egypt, Zaher *et al.* (2007) reported 16 human cases (9 *P. falciparum* imported pilgrims and 7 *P.vivax* locally acquired reported in Almaza Fever Hospital. El-Bahnasawy *et al.* (2010) evaluated malaria among patients admitted to the Military Fever Hospitals, 36 patients were included 20 already diagnosed as malarial patients recruited from Peace Keeping Mission Forces in Africa and 16 cases were from different Egyptian areas. El Bahnasawy *et al.* (2011) declared that the endemicity of chloroquine resistant *P. falciparum* on the Egyptian-Sudanese border pave the way for malignant malaria transmission particularly among travelers returning back from Sudan. Dahesh and Mostafa (2015) reported that all malaria cases were imported from Sudan. But, an outbreak of *falciparum* (1 case) and *vivax* (23 cases) that occurred (May 2014) in Aswan Governorate indicated that malaria is reemerging in the country. They added that 14/2044 examined persons (0.68%) were passive cases attended themselves to Fayoum Malaria Units when back from Sudan, with *P falciparum* & *P. vivax* formula of 33.3% & 66.7% respectively. Kenawy (1988) reported that *Anopheles pharoensis* was *P. vivax vector* and *An. sergenti* was *P. falciparum vector* in El Fayoum, and *An. multicolor* was suspected as a vector in El Gara Oasis (Kenawy *et al*, 1986). Wassim (2014) reported by 2^{ry} structure and sequence of ITS2-rDNA *An. Pharoensis* an important vector all over Egypt, mainly in the Delta, *An. sergenti* a primary vector in the Western Desert Oases, *An. multicolor* in Fayoum, *An. stephensi* in Red Sea Coast, and *An. superpictus* in Sinai.

In Egypt, so many authors dealt with viral hepatitis, the selected ones summarized the status. WHO (2016) reported that over the past few years, the remarkable developments in the global commitment to address viral hepatitis. A total of 194 countries of the World Health Assembly unanimously adopted the first-ever Global Health Sector Strategy on viral hepatitis; 2016-2021. Doss *et al.* (2018) reported that Egypt had recognized the enormous health, social and economic burden of hepatitis infection, which was the driver to establish national response to fight

the disease. It became clearer that the root causes, as well as catalysts of transmission of HCV and HBV, were strongly associated with healthcare-related malpractices. There was an indication to establish a comprehensive Infection Prevention and Control programme in the Egyptian Ministry of Health and Population. Such a program was successfully launched in 2001 and succeeded in improving adherence to infection prevention and control practices and developing the national infection control guidelines.

Elbahrawy *et al.* (2021) reported that an estimated 8-10 million people suffered from viral hepatitis in Egypt. Hepatitis A virus & hepatitis E virus are the major causes of viral hepatitis in Egypt as 50% or more of the Egyptian population was already exposed to HAV infection by the age of 15. They added that over 60% of the Egyptian populations test seropositive for anti-HEV in the first decade of life. HEV mainly causes self-limiting hepatitis, but cases of fulminant hepatitis and liver failure were reported in Egypt. HBV, HCV, and hepatitis D virus (HDV) are the main causes of chronic hepatitis, liver cirrhosis, and liver cancer (hepatocellular carcinoma [HCC]) in Egypt. Globally, Egypt had the highest age-standardized death rate due to cirrhosis from 1990 to 2017. Prevalence rate of HBV (1.3%-1.5%) declined after national infantile immunization. Co-infection of HBV patients with HDV is still common in Egypt with antibodies (IgG) varied from 8.3% to 43% among HBV patients. After the conduction of multiple national programs to control HCV infection, a lower rate of HCV prevalence (4.6%) was recently reported. Data about the incidence of HCV after treatment with direct antiviral agents (DAAs) were lacking.

Chagas disease: Chagas disease (American trypanosomiasis, infection with the protozoan parasite *Trypanosoma cruzi* (*T. cruzi*)) was rarely reported to be transmitted by blood transfusion in North America, with less than 10 cases. Prior studies have suggested that the rate of *T. cruzi* transmission

was 13 to 26% per unit of contaminated blood transfused (Schmunis, 1999). However, more than 150 cases of transfusion-associated babesiosis were reported to date in the United States (Leiby, 2006). However, donor questioning about infection with these agents was restricted to asking them whether they have ever had either one of these diseases (Gerber *et al,* 1994). It was not clear whether adding questions about country of birth and travel to countries where Chagas disease is endemic identified donors at risk of *T. cruzi* transmitting (O'Brien *et al,* 2008).

Data on Chagas disease indicate that the risk to transfusion recipients in the United States and elsewhere may have been growing over the last two decades. Transfusion transmission occurs at high rates in endemic countries as Mexico and other Central and South American Countries without the donor laboratory testing.

In Spain, overall donor seroprevalence for *T. cruzi* was 0.62%, and was 10.2% in donors born- in Bolivia (Piron *et al,* 2008). But among blood donors in five blood banks in the cities of Guadalajara and Tepic, Mexico, where routine screening is not performed, the rate of confirmed *T. cruzi* antibody was 0.75% (Kirchhoff *et al,* 2006), and may be as high as 2.8% in other parts of Mexico (Guzmán Bracho *et al*, 1998).

Immigration and blood donation patterns indicate that an increasing number of donors with chronic asymptomatic *T. cruzi* infection are entering the United States blood supply. In a study evaluating donors between 1994 & 1998, donors in two communities with large Hispanic populations (Los Angeles and Miami) were asked if they were born, or had spent more than six months, in countries in which Chagas disease is endemic (Leiby *et al,* 2002). Donors responded with yes comprised 7% in Los Angeles and 14% in Miami. Prevalence of confirmed *T. cruzi* seropositivity was about 1/ 8000 (0.012%) for all donors in the two cities. On subsequent evaluation, over one-half of these donors were proved to be intermittently parasitemic and

thus potentially infectious. Moreover, targeted donor questioning was not sufficient to identify all of potentially infectious donors. A report completed in 2006 found a fourfold higher rate of *T. cruzi*-positive blood donors; 1/2000, or 0.05% (Stramer *et al*, 2007), but from El Paso, Texas area showed a seroprevalence of 0.03% (Tobler *et al,* 2007). Based on these considerations, FDA, in December 2006, approved an ELISA blood donor screening test (ORTHO® *T. cruzi* ELISA Test System) with 100% sensitivity and 99.9% specificity. Although unmandated for use by the FDA, yet test was implemented in 2007 by the US blood majority collectors. Data from the American Red Cross indicate that during the first year of testing, about 1 in 30,000 US donors tested positive (by screening assay or a confirmatory test) for *T. cruzi* antibody, highest antibody prevalence in California and Florida (Stramer *et al,* 2008). Chagas disease was once entirely confined to continental rural areas of the region of the Americas (excluding the Caribbean islands). Due to increased population mobility over previous decades, most infected people now live in urban settings and the infection has been increasingly detected in the USA, Canada, and many European and some African, the Eastern Mediterranean & Western Pacific Countries (WHO, 2022a).

In Egypt, neither *T. cruzi* nor the winged bug was reported even the Middle East Countries. Only a zoonotic Egyptian human trypanosomiasis *evansi* case was reported out of 30 dromedary camel breeders with 15% infected in camels (Haridy *et al,* 2011).

Babesiosis: Babesiosis is a potentially life-threatening disease endemic in USA caused by intra-erythrocytes' parasites, which usually are tick-borne but also are transmissible by transfusion **(**Scholtens *et al***,** 1968). Herwaldt *et al.* (2011) in USA reported that the tick-borne transmission of *Babesia microti* mainly occur- red in 7 States in the Northeast and the upper Midwest of the United States, which donor-screening strategies that mitigated the risk for transfusion transmis-

sion are needed, and must be included in the differential diagnosis of un-explained post-transfusion hemolytic anemia or fever, regardless of the season or region. Leiby (2011) reported that not only *B. microti* became established as a public health concern; this agent was increasingly and transmitted by blood transfusion**.** He added that several hurdles remained, including without a licensed blood screening assay and a thorough cost-benefit analysis of proposed interventions. Bloch *et al.* (2012) reported one patient had the third documented transfusion case caused by *B. duncani,* which underscores the fact that babesiosis can be caused by agents not detected by molecular or serologic analyses for *B. microti.* Bloch *et al.* (2022) in USA by using the National Inpatient Sample database to characterize the epidemiology of the *Babesia*-associated admissions reflected the severe *Babesia*-related disease. Over seven-year period, 7,818 hospitalizations listed babesiosis as a primary or secondary admitting diagnosis. They added that hospitalizations were seasonal (71.2% during June-August) and situated overwhelmingly in the Northeast and Midwest. Patients were predominantly old males, with expected epidemiology. Despite higher severity (58.5%), mortality rate was (1.6%). Comparison with state reporting data showed that the hospitalized babesiosis patients increased modestly during the observation period.

In Egypt, Nagaty (1947) listed species of *Babesia* and *Theileria*. Maronpot and Guindy (1970**)** reported *B. gibsoni* in wild carnivores and stray dogs. Michael *et al.* (1987) in Minia Governorate (G.) reported first human babesiosis. El Bahrawy *et al.* (1993) detected *Babesia* spp. in *Rattus rattus* & *R. norvegicus* in five governorates. Mazyad and Khalaf (2002) in the North Sinai G. reported *B. ovis* and *Theileria ovis* in sheep, goats, cattle and camels. Farah *et al.* (2003) found natural *B. equi* in horses. El Kammah *et al.* (2007) reported *Baberia bigemina* and *B. canis* in the saliva and midguts of 8 ixodid and 2 argasid species. El Bahnasawy and

Morsy (2008) presented the second Egyptian human babesiosis. Patient was diagnosed by detecting *Babesia* species in blood smears, and treated with quinine and clindamycin, and El Bahnasawy *et al.* (2011) reported a babesiosis boy who acquired infection from pet-dog. Bajer *et al*. (2014) in Sinai Governorate reported *B. behnkei* a novel species of *Duncani* group isolated *Dipodillus dasyurus* in Sinai.

Leishmaniasis: It is a wide clinical manifestations caused by parasites of genus *Leishmania*, generally spread by bite of female sandflies, *Phlebotomus* (Old World) or *Lutzomyia* (New World). Leishmaniasis is present in three forms: cutaneous (CL), mucocutaneous (MCL, or visceral (VL). The CL form presents with skin ulcers, but the MCL form presents with ulcers of the skin, mouth, and nose, and the VL starts with skin ulcers and later presents with fever, low red blood cell count, and enlarged spleen and liver affecting all reticulo-endothelial systems (Barrett and Croft, 2012). Out of 200 countries and territories reporting to WHO 97 ones and territories were leishmaniasis endemic countries. About 95% of CL cases occur in the Americas, the Mediterranean basin, the Middle East and Central Asia. In 2020, over 85% of new CL cases occurred in 10 countries: Afghanistan, Algeria, Brazil, Colombia, Iraq, Libya, Pakistan, Peru, the Syrian Arab Republic and Tunisia. In the Persian Gulf War of 1991, several cases of atypical cutaneous leishmaniasis that featured a visceral component were reported in US military personnel. Further concern about this issue resurfaced with report of 22 CL cases in US military personnel deployed to the Middle East during 2002-2003, primarily to Afghanistan, Iraq, and then Kuwait (CDC, 2003). Thus, as a precautionary measure against a possible blood-borne phase that might be undetected in the currently reported cases, the AABB and United States Armed Services Blood Program Office of the Department of Defense (DOD) implemented policies to defer prospective blood donors from

donating blood for 12 months after the last date they left one of these countries (Cardo, 2006). There have been at least 10 probable or confirmed cases of transfusion-transmitted leishmaniasis; most cases were reported more than 40 years ago and no such case were reported in the United States (Mestra *et al,* 2011). It was estimated that between 600 000 to 1 million new cases occur worldwide annually (WHO, 2022b).

In Egypt, Kabil *et al.* (1988) in Benha district found infantile visceral leishaminasis (IVL) in the spleen an adult patient with hepatosplenomegaly. Morsy *et al.* (1988) in Sinai mapped the wild rodent reservoirs. Morsy *et al.* (1989) identified *Phlebotomus langeroni* the vector of IVL in Alexandria; Morsy *et al.* (1990) gave a key for identification of the nine *Phlebotomus* species in the Nile Delta. Egyptian endemic zoonotic cutaneous leishmaniasis (Morsy, 1996), and cases of IVL Morsy (1997) were reviewed. El-Bahnasawy *et al.* (2013) in north coastal zone reported that *Ph. langeroni* with suspension of IVL re-emergency Again, Morsy (2013) incriminated cutaneous leishmaniasis as a predisposing risk to skin cancer.

Toxoplasmosis: *Toxoplasma gondii* a protozoan parasite that infects most species of warm-blooded animals, including humans, causes toxoplasmosis. Definitive hosts are members of family Felidae (pet and stray cats and relatives). Unsporulated oocysts are shed in large numbers with cat's feces, usually for 1-3 weeks; take 1-5 days to sporulate in environment to be infective. Intermediate hosts in nature (including birds and rodents) become infected after ingesting soil, water or plant materials contaminated with oocysts, which transformed into tachyzoites after ingestion. They localize in neural and muscle tissue and develop into tissue cyst bradyzoites. Cats become infected after consuming the intermediate hosts (rats) harboring tissue cysts. Cats may become infected directly by ingestion of sporulated oocysts. Edible nimals for human consumption and wild game may also become infected with tissue cysts

after ingestion of sporulated oocysts in soil. Humans can become infected by any of several routes: 1- Eating undercooked meat of animals harboring tissue cysts, 2- Consuming food or water contaminated with cat feces or by contaminated environmental samples (as fecal-contaminated soil or cleaning a pet cat litter box), 3- Blood transfusion or organ transplantation, or 4- Transplacentally from a mother to fetus (CDC, 2022).

Anti-*Toxoplasma* antibodies were reported in the healthy blood donors worldwide. This was true as in Kenya (Griffin and Williams, 1983), Eastern Saudi Arabia (Sarwat *et al*, 1993), the Czech Republic (Svobodova and Literak, 1998), Northeast Thailand (Pinlaor *et al*, 2000), Bamako (Maiga *et al*, 2001), Malaysia (Nissapatorn *et al*, 2002), Kuwait (Iqbal *et al*, 2003), Northeast Brazil (Coelho *et al*, 2003), Turkey (Yazar *et al*, 2006), Mexico (Alvarado-Esquivel *et al*, 2016), India (Sundar *et al*, 2007), Cairo Egypt (Elsheikha *et al*, 2009), Iraq Zghair *et al*. (2015), Iran (Karimi *et al*, 2016) and Scotland (Burrells *et al*, 2016). Apart from blood, transmission of *T. gondii* was reported by the whole or white blood cell transfusions (Galvan *et al*, 2005) or the renal transplantation in cat and dog (Bernstein *et al*, 1999), or CMV in renal transplant recipients (Barsoum, 2006; Campbell *et al*, 2006; Hamza *et al*, 2015) from positive donors to recipients.

Creutzfeldt-Jakob disease (CJD) is a rapidly progressive, invariably fatal neurodegenerative disorder believed to be caused by an abnormal isoform of a cellular glycoprotein known as prion protein. CJD occurs worldwide and the estimated annual incidence in many countries, including the United States that reported to be about one/ million population.

Creutzfeldt-Jakob disease: Creutzfeldt-Jakob disease (CJD) is a rare, fatal, degenerative neurologic disorder with a long asymptomatic latent period; it was thought to be caused by a prion. Sporadic (sCJD), familial (fCJD), iatrogenic (iCJD), & CJD variant forms (vCJD) were recognized. The so-called iatrogenic CJD is transmitted from human to human by the transplantation of dura mater layer, by corneal transplantation in a single ase, by the injection of pituitary derived human growth hormone, and by the reuse of the EEG electrodes.

Epidemiologic studies (including a review of mortality data in heavily transfused recipients, neuropathological studies of deceased patients with hemophilia, and look-back studies assessed the health outcome of recipients who received blood components from donors who subsequently developed iCJD) have confirmed earlier studies failed to establish a link between transfusion and CJD transmission (Evatt *et al*, 1998). There was an emerging consensus that iCJD was not transmitted by transfusion, but if so was very rarely (Dodd and Sullivan, 1998). Creutzfeldt-Jakob disease (CJD) is a rapidly progressive, rare, transmissible, globally fatal, neurodegenerative conditions caused by prion proteins. This condition was first described in 1920 by Hans Creutzfeldt, later described in 1921 & 1923 by Alfons Jakob. Later, J. Gibbs used using the term Creutzfeldt-Jacob disease (CJD) because the acronym was closer to his initials (Sitammagari and Masood, 2022). CDC (2021) reported that classic CJD is a human prion disease. It is a neurodegenerative disorder of characteristic clinical and diagnostic features. This disease is rapidly progressive and always fatal. Infection leads to death usually within one year of onset of illness.

Variant Creutzfeldt-Jakob disease (vCJD) is the fatal, degenerative neurologic disease newly discovered in the United Kingdom (Will *et al*, 1996). As of October 2008, 206 definite or probable cases were reported worldwide, with 167 in the UK, 23 in France, and smaller numbers in some other countries (WHO, 2011). The vCJD etiologic agent (probably a prion) is the same agent caused bovine spongiform encephalopathy; BSE, mad cow disease (Hill *et al*, 1997). Soon after vCJD discovery, risk of transfusion transmission of this agent in humans was regard-

ed as theoretically possible, based upon differed biology from classical CJD and experimental transmission of BSE by transfusion in animal systems (Houston *et al*, 2008). In the last years, several case reports showed that such transmission occurred, with four cases of probable transfusion transmission of vCJD agent reported in the UK, three cases were clinical and fourth one was preclinical (Hewitt *et al*, 2006). The four cases occurred among 66 recipients who were due to receiving blood transfusion from a donor who later developed vCJD. The four vCJD recipients comprised 14% of the 29 recipients surviving for more than 5 years and indicated a high transmission rate (Lefrère and Hewitt, 2009). Besides, a hemophiliac recipient of Factor VIII concentrates pre-1996 in the UK had evidence of the vCJD prions in his spleen at autopsy, indicated possible subclinical transmission from transfusion of these factors concentrates.

In the first clinical case, variant CJD was diagnosed in the transfusion recipient 6.5 years after the receipt of a non-leukoreduced red cell unit from a donor who later died from vCJD 40 months after the blood donation (Llewelyn *et al*, 2004). In the second clinical case, a transfusion recipient developed vCJD seven years following transfusion of a non-leukoreduced red cell unit from an implicated donor, developed vCJD symptoms approximately 18 months after blood donation. In the third clinical case, a transfusion recipient developed vCJD 8.5 years after transfusion of a non-leukoreduced red cell unit from the same donor as in the second case, which preclinical transfusion-transmitted vCJD was uncovered by autopsy investigation who died of a non-neurologic disorder five years after receiving a unit of non-leukoreduced red cells (Peden *et al*, 2004). This subject didn't have neurologic symptoms at death time. The blood donor showed vCJD symptoms 18 months after donation; vCJD was proved at autopsy.

While transmission of vCJD by blood transfusion was documented, there was none

case of transmission of iCJD by blood transfusion. However, due to disease phase long incubation (from growth hormone transmissions) and the inability of conventional sterilization methods to inactivate the organism, there is a theoretical risk of iCJD transmission from asymptomatic donors to blood transfusion recipients (Ricketts *et al*, 1997).

Brandel and Knight (2018) in France reported that variant CJD (vCJD) was described first in the United Kingdom in 1996, as a zoonotic form of human prion disease, originating from dietary contamination of human food with material from bovine spongiform encephalopathy (BSE)-affected cattle. It has important epidemiologic, clinical, & neuropathogic differences from other forms of human prion disease. Cases have occurred in several countries, but the United Kingdom and France were most affected. Following the decline in BSE in cattle and the dietary protective measures adopted, vCJD became an extremely rare disease. But, important concerns remain about asymptomatic infection in human populations (mainly the United Kingdom) and the possibility of man-to-man transmission via medical and surgical interventions. Definitive diagnosis depends on neuropathology always undertaken at autopsy, but sometimes on brain biopsy. Clinical diagnosis with a reasonable degree of likely is, but possible based on the clinical features and finding of the pulvinar sign on cerebral magnetic resonance. The new vCJD tests, including blood one, with promising sensitivity and specificity, but, it is a progressive illness, inevitably fatal without curative treatment.

In Egypt, Zilber *et al.* (1991) in Israel reported in a country-wide study of Creutzfeldt-Jakob disease (CJD) was diagnosed in 114 Israeli cases, among them 49 Libyan-born, with onset of their disease during the years 1963-1987. After age adjustment, the mean annual incidence rate per million populations was 43 among Libyan-born and 0.9 in the rest of the population. Among Jews born in Egypt and Tunisia, the adjusted rates were

higher than in the other Israelis (3.5 & 2.3 per million, respectively). Among Libyan Jews, there was no association between incidence rate of CJD and age at immigration, i.e., duration of exposure to hypothetical infectious factor in Libya. The familial cases among Libyan Jews (41 to 47%) was one of the highest ever published. Genetic factors seem to be important for the high incidence of CJD among Libyan Jews.

Negm and Hashish (2019) in Suez Canal University reported "a case of a 65-year-old man, with progressive gait instability and impaired cognition with normal brain MRI. After 1 week, his symptoms became worse, EEG showed periodic sharp wave complexes, suggestive of Creuzfeldt-Jakob disease, and CSF was normal. One week later, he developed bradyphrenia and myoclonic fits. Brain MRI showed hyper-intensities mainly in the right frontal and occipital cortical gyri and caudate areas. After a few days, the patient developed akinetic mutism intractable fits, was admitted to the ICU, and deceased after a few days".

Blood donor deferral: To eliminate possible risk to transfusion recipients of the developing CJD, the FDA recommended that all prospective blood donors who have received human pituitary derived growth hormone, a dura mater transplant, or have a family history of CJD in a blood relative be permanently deferred (Wilson an Ricketts, 2004).

In an attempt to balance the increased safety against decreased blood availability, the FDA adopted a vCJD deferral policy based on length of time in countries where persons may be exposed to BSE. Since virtually all reported vCJD cases occurred in the United Kingdom, deferral of donors who have traveled to the United Kingdom during the peak period of exposure to BSE infected cattle (1981 to 1996) was deemed by the FDA in 2000 to be a means of reducing the hypothetical risk of transmission of vCJD by transfusion (Murphy *et al,* 2004). Also, due to an increased number of BSE cases in other European Countries, the FDA subsequent-

ly broadened their donor deferral criteria. The updated criteria defer prospective donors with one or more of the following: a-Have spent ≥3 cumulative months in the UK from 1980-1996, b- Have spent ≥5 cumulative years in Europe from 1980-present, c-As current or former US military personnel, civilian military employees and their dependents, have lived for ≥6 months at US military bases in Northern Europe from 1980-1990 or elsewhere in Europe from 1980-1996, d- Received a blood transfusion in the UK or France between 1980 -present, and e-Injected bovine insulin sourced from the UK or other countries with BSE (Millar and Makris, 2012). While the UK and France exclude blood donors with a prior tra-nsfusion history, the German Federal Minister of Health recommended in April 2006 that persons with a transfusion history not be excluded from donating blood (Dietz*et al,* 2007).

West Nile virus infection (WNV): Blood Banks in the United States since 2003 have performed nucleic acid testing for WNV as a routine screening procedure (Zeller and Schuffenecker, 2004). Based on data from transfusion-transmitted WNV cases occurring in 2002 prior to the onset of such testing, it was hypothesized that a question asking about the occurrence of fever and headache in the week prior to donation might provide additional protection against WNV transmission. Such a question was added to the donor history (FDA, 2003). A subsequent evaluation of two years of data from donors with laboratory-proven WNV infection failed to find a correlation between the pre-donation symptoms and WNV infection. Thus, this history question was dropped from the donor questionnaire. As with other acute viral syndromes, a general donor history question about whether the donor feels well may elicit the presence of non-specific systemic complaints led to donor deferral (Orton *et al,* 2006). Depoortere *et al.* (2004) in Sudan Nuba Mountains reported WNV outbreak among severe neurological children.

In Egypt, Out of 21 authors dealt with the

WNV, the following were selected. Mohammed *et al*. (1970) in Alexandria Fever Hospital examined 120 children for arboviruses, reported that WNV was a risky public health infectious one. Darwish *et al*. (1987) in Imbaba Fever Hospital reported that a case of WNV among 55 patients with fever, myalgia, acute and convulsion. Corwin *et al*. (1992) in Bilbeis district schoolchildren reported antibody prevalence of (15/437) for WNV & 9% (28/ 315) for Hanta (HTN) virus. Abbassy *et al*. (1993) reported that WNV infection in experimentally infected *Argas arboreus* ticks and documents horizontal and vertical transmission. El-Esnawy (2001) in Egyptian manual workers at sewage treatment plants (STPs) found that WNV was 143/ 264 (54.14%). Kropman *et al*. (2012) in the Netherlands reported WNV in a 44-year-old female back from a holiday in Egypt. Many mosquitos' species allover Egypt was reported (Morsy *et al*, 1990; 1995; 2004; El-Bashier *et al*, 2006; Mikhail *et al*, 2009; Shoukry and Morsy, 2011), and El Bahnasawy *et al*. (2013) gave an overview WNV and concluded that it spread globally to Europe beyond the Mediterranean Basin and the States, is now considered to be an endemic pathogen worldwide especially in Africa. Also, Busch *et al*. (2006) in USA reported WNV in blood donors. Alfaresi and Elkoush (2008) in UAE reported WNV in blood donors. Gallian *et al*. (2010) in Lebanon found WNV in blood donors at Hôtel-Dieu de France.

Bacterial infections: Bacterial infections are another potential fatal complication of transfusion of bacterial infection. It represented the foremost infectious risk from transfusion of the blood products. This is most commonly due to bacterial contamination during the processing or storage of blood products [direct effect], but there is increasing recognition of an indirect effect. Blood transfusion is associated with immunomodulation which may result in increased risk of infection. Leukocyte reduction of blood reduced the risk of health care-associated infections (Lannan *et al*, 2013). In a review of health care-associated infection after RBC transfusion, restrictive transfusion compared to liberal transfusion strategy didn't reduce the overall health care-associated infections, but reduced the risk of serious infections and particularly significant for patients undergoing hip and knee arthroplasty as well for septic ones (Rhode *et al*, 2014).

Bacterial contamination of blood products can be from the donor's skin (i.e., *Propionibacterium acnes* or staphylococci) or from bacteria contaminated environment: *Yersinia, Pseudomonas, Proteus, Escherichia coli, Klebsiella, Acinetobacter,* and *Serratia* or septic transfusion reaction mainly from platelet rather than RBC transfusion. Estimated risk of blood products contaminated with bacteria was 1 in 5000 for platelets and 1 in 30,000 for RBC (Zia, 2017). Kreuger *et al*. (2017) in the Netherlands reported evidence from that platelet concentrate stored in platelet additive solution was associated with the fourfold increased risk of bacterial infections. FDA (2013) in the USA, approximately 2.2 million units of platelets were transfused yearly (2011) and over a 5-year period from 2009 to 2013, 13 fatalities from bacterial contamination of platelet products were recorded, 2.6/year or ≈1.3 per million platelet transfusion. FDA, (2015) reported that it didn't appear to be any improvement, as 5 fatalities were recorded from a bacterial infection *Staphylococcus aureus* counted for the greatest number of deaths due to contamination in the preceding 5 years (5/18) & others associated with fatalities included: *Serratia marcescens, Klebsiella pneumoniae, Morganella morganii, Pseudomonas fluorescens, Acinetobacter* species*,* and *Enterococcus faecium.* The passive surveillance for bacterial contamination of platelets was reported with the culture of platelet samples. In a study over a 7-year period (2007-2013), 20 of 51,440 platelet units transfused were bacterially contaminated (0.004%; 389/million) and caused only 5 septic transfusion reactions (Hong *et al*, 2016). In high-income countries as Sub-Sahara, bacterial contamination of platelets

by commonest transfusion-transmitted infections, ranged from 0.01 to 0.07% of platelet units, but rates were less high in resource-poor countries such as in Africa. Bacterial contamination rate in whole blood or RBC concentrate in seven sub-Sahara Africa studies averaged 8.8% and platelet contamination was much higher (Hume *et al,* 2016). To prevent bacterial contamination of platelets the FDA recommended enhanced bacterial testing or pathogen reduction/inactivation strategies or both. A system combines ultraviolet A and amotosalen for broad-spectrum pathogen inactivation was approved in the USA and Europe (Levy *et al,* 2018). But, blood was not collected from febrile persons at the time of donation, who stated that they didn't feel well, or who were on systemic antibiotics (WHO, 2012) These requirements are also applied to candidates for autologous donation, since cases of transfusion-induced sepsis in autologous recipients occurred due to the ability of Gr-am negative rods to multiply at refrigerator temperatures and secrete endotoxin into blood bag (Richards *et al,* 1992). Autologous donors on antibiotics or with a history of recent or concurrent medical procedures must be evaluated for bacteremia possibility and thus was deferred (Smith and Nehring, 2021).

Other Recipient Safety: 1- History of malignancy in donor: Donors with a history of malignancy pose a theoretical risk to recipients; however, no cases of transfusion-transmitted malignancy have been reported, nor have epidemiological studies found such an association. Since many transfusion recipients are immunosuppressed, it may be theoretically possible that malignant cells circulating in a donor's blood could engraft and multiply in a recipient, provided there was a sufficient degree of genetic matching. To decrease this possibility, they were asked about a history of cancer (Greenwald *et al,* 1976).

In blood centers, a donor with a history of a solid organ tumor will be deferred and will be eligible to donate only if he/she has been symptom-free and considered to be clinical-ly cured for a defined time period. This period usually ranges from one to five years at different blood centers. Donors with a history of hematologic malignancy are permanently deferred; in comparison, donors with specific malignancies (e.g., basal cell cancer of skin, cervical carcinoma in situ) that have been fully excised are not deferred, as tumor is known to be low grade and not capable of hematogenous spread (Edgren *et al,* 2007).

Medications taken by donor: Most medications taken by donors pose no known risks to recipients. In most cases, only small quantities of drugs are present in a unit of blood and drugs under went significant dilution in the recipient's plasma volume. But, some drugs may pose a risk due to their demonstrated teratogenic potential at low plasma concentrations. Five such medications (all pregnancy category X) were identified by FDA as potentially dangerous to recipients: these are etretinate (Tegison) used for severe psoriasis, acitretin (Soriatane) also used for severe psoriasis, isotretinion (Amnesteem, Claravis, Sotret, formerly called Accutane) used for severe cystic acne, finasteride (Propecia, Proscar) used for symptomatic benign prostatic hypertrophy and hair regeneration, and dutasteride (Avodart) used for benign prostatic hypertrophy (FDA, 1993b). Deferral periods are one month for isotretinoin and finasteride, six months for dutasteride, three years for acitretin, and permanent for etretinate due to its presence in plasma several years after cessation of use. Also, donors are permanently deferred if they have taken bovine insulin (risk of variant CJD transmission) or human growth hormone derived from pituitary glands (risk of iatrogenic CJD). Donors received Hepatitis B immunoglobulin (HBIG) or an unlicensed vaccine is deferred for one year. At discretion of the medical director, most donors are also temporarily deferred if they are taking warfarin, heparin, or another anticoagulant. This is due to effects of these medications on therapeutic efficacy of plasma components and potential for impaired hemostasis in donor after colle-

ction procedure (Despotis and Joist, 1999).

Aspirin and aspirin-contained medications: Recommendations for the platelets collections by apheresis, stated collections must not occur from donors who ingested aspirin, aspirin-contained drugs, or feldene in the previous 48 hours or from donors who ingested clopidogrel or ticlopidine in the previous 14 days (FDA, 2009). Although donation centers routinely ask about these medications, which might interfere with platelet function and defer prospective platelet-apheresis donors accordingly, there was no routine quality control testing of platelet function for platelet apheresis products (Jilma-Stohlawetz *et al,* 2001). This is due in part to the poor predictive value of in vitro tests for predicting in vivo platelet function. This donation restriction is specific to plateletpheresis donors and does not apply to whole blood donors unless platelets made from that unit of whole blood will be the sole source of platelets for a given patient. This would only apply only to platelet transfusions designated for neonatal and young pediatric recipients.

Protection of donor: Donors are asked about their overall state of health as well as specific questions about cardiac and pulmonary problems. In general, donors with coronary artery disease, cardiac valvular disease, arrhythmia, significant cerebrovascular disease, or heart failure are deferred, as are those with any active pulmonary disease impairing gas exchange.

• Donors who have undergone recent surgery in the absence of blood transfusion are deferred until healing is complete and full activity has been resumed.

• Donors who are pregnant are deferred during pregnancy and for six weeks after delivery.

• Donors with seizure disorders are acceptable provided that they have had no seizures within the past 12 months with or without medications. This policy appears reasonable since there are no data linking the convulsive activity associated with seizure disorders to the convulsive activity that occurred after ischemia from a post-donation vasovagal reaction (van der Linden *et al,* 1986).

The minimal age for donation is legally established by individual states in the United States and is generally 16 to 18; donors who are legally minors need written consent of a parent or guardian. The upper age for blood donation has changed over the past decade, following studies documenting those individuals over the age of 65 who met all other donation criteria had no greater frequency of severe or life-threatening reactions and had lower rates of post-transfusion reactions than younger donors (Schmidt, 1991). Most blood centers no longer impose an upper age limit for donor eligibility.

Conclusion and Recommendations

Undoubtedly, and first of all the blood donors and patients' health education is a must.

Recipient protection: 1- Donors are asked questions concerning their sexual activities, their injection drug use history, their prior HIV testing history, and their history of selected sexually transmitted diseases. 2- Donors are queried concerning exposure to or medical history of Hepatitis, Malaria, Toxoplasmosis, Babesiois, and Chagas disease, visceral Leishmaniasis and Creutzfeldt-Jakob disease 3- Donors are asked about their travel history (relevant to exposure to malaria or babesiosis or toxoplasmosis or vCJD) and whether they have received a blood transfusion in the last year. 4- Donors are asked about recent vaccinations. Blood is not collected from persons who are febrile at the time of donation, who state that they do not feel well, or who are taking systemic antibiotics. 5- In most blood centers, a donor with a history of a solid organ tumor may be deferred and eligible to donate only if he/she was symptom-free and considered to be clinically cured for a defined time period. Donors with a history of hematologic malignancy are permanently deferred. 6- Some drugs may pose a risk due to their demonstrated teratogenic potential at low plasma concentrations. Deferral time is a month for isotretinoin and finasteride, 6 months for dutasteri-

de, 3 years for acitretin and permanent for etretinate. 7- Donors are permanently deferred if they have taken bovine insulin (risk of variant CJD transmission) or human growth hormone derived from pituitary glands (risk of iatrogenic CJD). Donors who received HBIG or an unlicensed vaccine are deferred for one year. At the discretion of the medical director, most donors are also temporarily deferred if they are taking warfarin, heparin, or another anticoagulant. 8- Collections of platelets for pheresis should not occur from donors who ingested aspirin, aspirin-containing drugs, or feldene in the previous 48 hours or from donors who ingested clopidogrel or ticlopidine in the previous 14 days.

Donor protection: 1- General, donors with coronary artery disease, cardiac valvular disease, arrhythmia, significant cerebrovascular disease, or heart failure are deferred, as are those with any active pulmonary disease impairing gas exchange. 2- Donors who have undergone recent surgery in the absence of blood transfusion are deferred until healing is complete and full activity is resumed.

3- Donors who are pregnant are deferred for six weeks after delivery. 4- Donors with seizure disorders are acceptable provided that they have had. no seizures within the past 12 months with or without medications. 5- Minimal age for donation is 16 to 18 depending on state laws. Most blood centers do not impose an upper age limit for donor eligibility.

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