National Institutes of Health

Fact Sheet *Transfusion Safety*

Yesterday

- The earliest attempts to transfuse blood, which sometimes entailed giving animal blood to humans, were often unsuccessful due to poor understanding of the fundamental immunologic principles of transfusion. It was not until the early 1800s that attempts to perform cross-species blood transfusions were finally abandoned.
- Improved understanding of the immunological components of transfusion, such as the discovery of the ABO blood group antigens by Karl Landsteiner in 1901, led to improved transfusion results. However, the extent of problems arising from transmission of infectious agents was just beginning to be appreciated.
- In the early 1980s, the AIDS epidemic emerged and a significant number of people were infected by receiving blood or blood products tainted with human immunodeficiency virus type 1 (HIV-1), the retrovirus that causes AIDS.
- The NIH funded the Retrovirus Epidemiology Donor Study (REDS) to determine the prevalence and incidence of HIV among blood donors and the risks of transmitting HIV and other viruses via transfusions. Since 1989, REDS has conducted these studies at selected blood centers throughout the country.
- A new technology, called nucleic acid amplification testing (NAT) greatly improved detection of HIV in donated blood. Previous HIV screening tests relied on detecting circulating antibodies. However, the time between viral infection and development of antibodies is often three weeks or more. During this "window period" the older tests could yield negative results for infected blood. NAT reduced the window period for HIV to as little as 11 days. Similarly, NAT reduced the window period for hepatitis C virus (HCV) from about 70 to 10 days.
- In 2003, with the emergence of the West Nile virus (WNV), the NAT procedure was rapidly modified to detect WNV. In just 9 months, a test for WNV was developed and approved by the Food and Drug Administration. As a result, nearly 1,000 blood donors with WNV infection were identified before their donations entered the blood supply.

Today

- REDS-II is now under way to improve the safety and availability of the U.S. blood supply. Its primary objectives are to monitor the appearance of newly discovered infectious agents in the blood supply, evaluate the characteristics and behaviors of voluntary blood donors, determine the causes of transfusion reactions of unknown etiology, assess the results of new donor screening methods, assess the effects of new blood bank technologies on blood safety and availability, and evaluate the donation process to improve the adequacy of the blood supply.
- Current REDS-II protocols are evaluating the risks of transfusion-transmitted infectious agents; the transmissibility of parvovirus B19 by blood transfusion; the prevalence of influenza virus in blood of otherwise healthy donors; the frequency and characteristics of HIV, HCV, and hepatitis B virus (HBV) in infected, permanently-deferred donors; and depletion of iron in blood donors.
- An international component of REDS-II is conducting epidemiological, laboratory, and survey research on blood donors in selected countries seriously affected by AIDS to ensure the safety and availability of blood for transfusion. The World Health Organization estimates that 5 to 10 percent of AIDS cases continue to be acquired from blood transfusions.

- Investigators are working to develop tests to detect transmissible spongiform encephalopathies, such as Creutzfeldt-Jakob disease (CJD) and new variant CJD, and to develop methods to inactivate or remove abnormal prion proteins from blood and blood components.
- NAT is now used to screen virtually all whole blood and plasma donations collected in the United States for HIV, HCV, and WNV, thereby reducing the risk of infection associated with blood transfusion to about 1 in 2,000,000 blood units. Before NAT screening, the risk of acquiring HIV was about 1 in 500,000 and the risk of HCV about 1 in 100,000.
- Ongoing research efforts continue to improve our understanding of the incidence, epidemiology, and mechanisms of transfusion-related acute lung injury (TRALI), a potentially life-threatening syndrome with an incidence of approximately 1 in every 5,000 units of blood and blood components transfused.
- Research is under way to address concerns regarding emerging threats, such as CJD and severe acute respiratory syndrome (SARS), and to respond to recent isolated human outbreaks of Chikungunya virus and avian influenza virus.

Tomorrow

- Newly developed technologies will routinely be used to provide rapid and accurate detection of infectious agents transmissible in blood, such as HIV, HCV, HBV, Chagas disease, and malaria. Tests will also detect emerging agents that pose a threat to transfusion safety.
- New tests will allow blood collection services to discern between individuals who have circulating HIV antibodies due to HIV infection and those who have antibodies due to previous immunization with an HIV vaccine.
- A wide range of safe and effective oxygen-carrying blood substitutes may become available that would be extremely useful when blood is not immediately available or in short supply, such as in the case of a rare blood type or a major disaster. The substitutes would be free of infectious agents and would pose no major risks of toxicity to recipients.

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