STUDENT HANDOUT
Using Blood-Typing to Determine Causes of Death in Surgery Patients

Background Information for Blood Diversity

The surface of erythrocytes contains genetically determined glycolipids called antigens. Antigens are categorized into blood groups, two of which are the ABO and Rh groups.

All cells in the body contain antigens on their surfaces. One person's antigens may be recognized as foreign if transferred into another person's body. This will trigger an immune response. As part of the immune response, particular lymphocytes secrete proteins called antibodies, which bind to antigens. Blood transfusions can be fatal if the antigens and antibodies are incompatible.

There are at least 20 different blood groups in red blood cells; the major group is the ABO system. Type A has only the A-antigen. Type B has only the B-antigen. Type AB has both A- and B-antigens, and type O has neither. Blood type denotes the class of antigens (glycolipids) found on the surface of the red blood cells.

Each person inherits two genes that control the production of ABO antigens. A and B are codominant, and O is recessive. The immune system does not attack its own red blood cell antigens. A-antigens do make antibodies against B, etc. (This is believed to result from the presence in the plasma of preformed antibodies, made in response to some common bacteria in the digestive tract.) O produces both anti-A and anti-B antibodies. AB produces neither.

Before transfusions are performed, a cross match is made by mixing serum from the recipient with blood cells from the donor. If the types do not match, the recipient's antibodies attach to the donor's red blood cells and form bridges, causing the blood to clump or agglutinate. A- and B-antigens are called agglutinogens. Antibodies against them are called agglutinins. The clumping causes blockage of small blood vessels. The red blood cells begin to hemolyze (rupture), releasing their hemoglobin into the bloodstream and causing severe kidney damage.

Type O is called the universal donor (if the plasma is removed and only the cells are given). The plasma would cause agglutination. AB is called the universal recipient, but agglutination could cause problems if the volume of blood given is too large. Because of the dangers involved, the universal donor/recipient concept is strongly discouraged.

Another group of antigens is called the Rh factor. Rh comes from Rhesus monkeys, where the antigen was first discovered. Eighty-five percent of the population has this and is known as Rh+. The other 15 percent who do not make this antigen are Rh–. Rh factor becomes a problem when an Rh– mother gives birth to an Rh+ baby. During the first pregnancy, this does not pose a problem because the blood is kept separate. During birth, a variable degree of exposure may occur and the mother's immune system may become sensitized and produce antibodies against the Rh antigen. If the mother does produce the antibodies, they can cross the placenta in subsequent pregnancies and cause hemolysis of the Rh+ red blood cells of the fetus. This can cause the baby to be born anemic (erythroblastosis fetalis or hemolytic disease of the newborn).

This problem can be prevented by injecting the Rh– mother with antibodies against the Rh factor within 12 hours of the birth of each Rh+ baby. The injection will inactivate the Rh antigens, preventing the mother from becoming sensitized.

History

When Europeans first started transfusions in the seventeenth century, many people died, so the process was outlawed in France, England, and Italy. The following are some significant dates in the history of blood research:

1901 Karl Landsteiner (an immunologist) discovered human blood groups.
1920 Landsteiner discovered another factor (the M, N, and MN factor).
1930 Landsteiner received the Nobel Prize for physiology and medicine.
1940 Landsteiner discovered the Rh factor.
1949 Barr bodies in white blood cells of females were discovered.