physiology

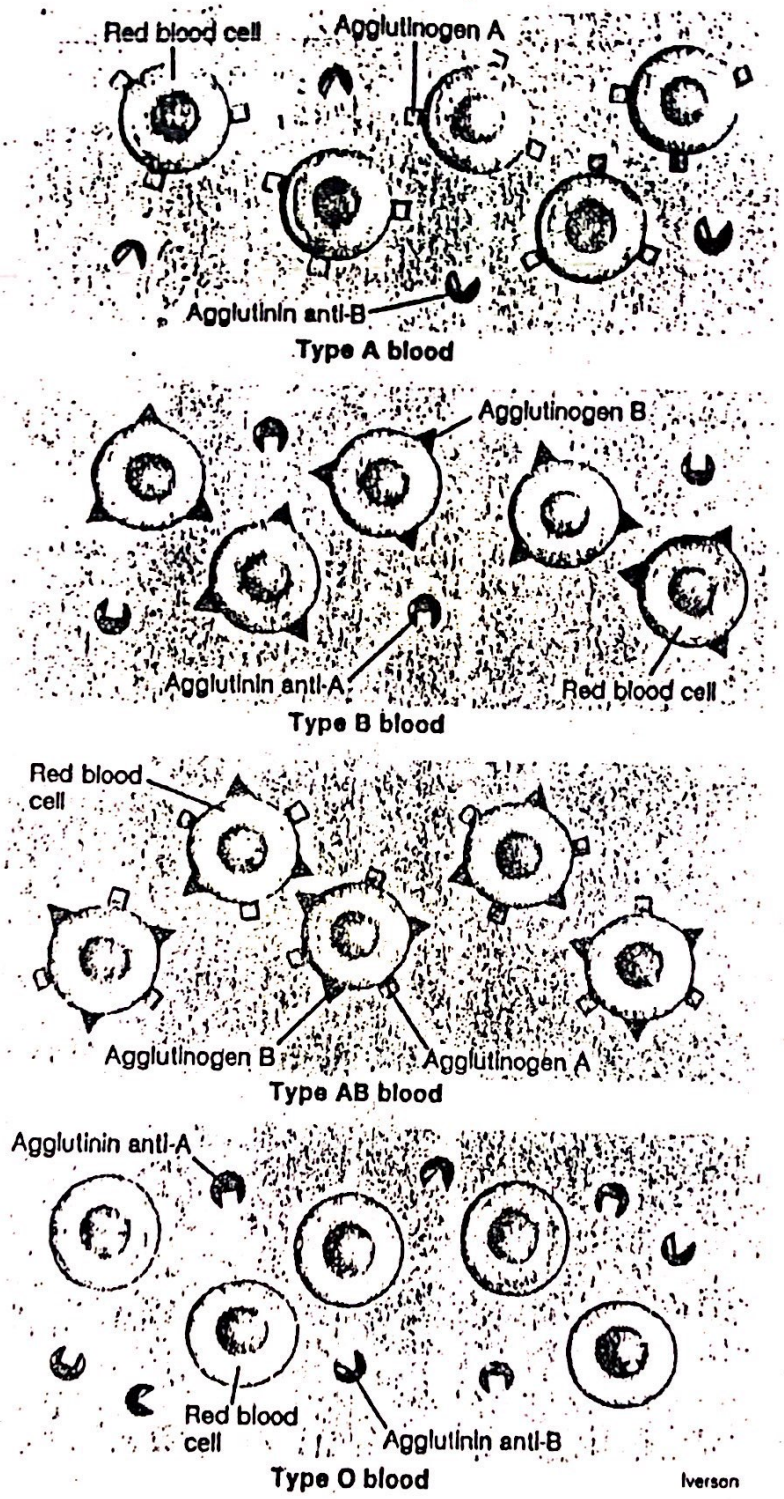

FIGURE 21.16
The antigens and antibodies present in types A, B, AB, and O blood groups.

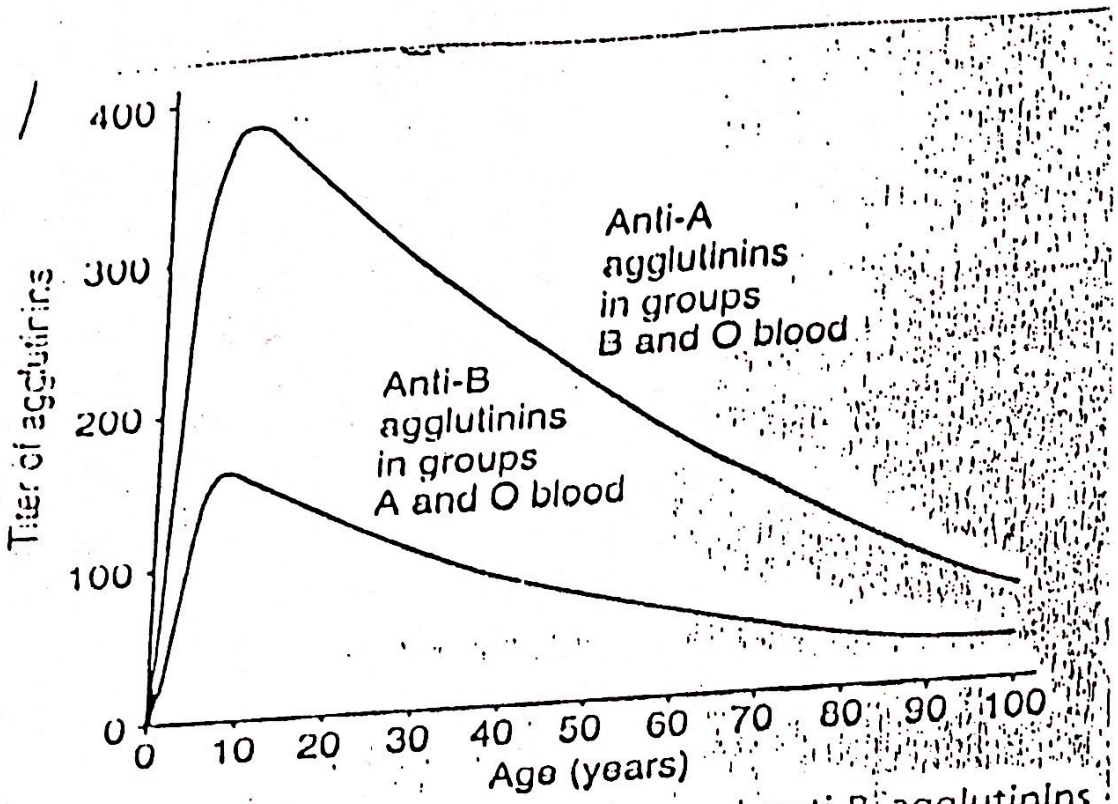

Figure 35–1. Average titers of anti-A and anti-B agglutinins in the blood of people in group B and group A at different ages.

Table 16.1 Racial Distributions of Blood Groups by Percent in the United States*

	A	B	AB	O	Rh+	Rh−
Whites	41	10	4	45	85	15
Blacks	28	20	5	47	90	10
Chinese	28	23	13	36	99	1
Indians (in Utah)	3	0	0	97	100	0
JORDAN*	39	14	8	39	97	3

*Data mainly from A. S. Wiener, *Blood Groups and Transfusion*, 3d ed. Springfield, IL: Charles C. Thomas, 1943.

* Sample of 300 medical Jordanian students.

Fortunately, this disease can be prevented by giving an Rh-negative mother human gamma globulin against Rh-positive erythrocytes within 72 h after she has delivered an Rh-positive infant. These antibodies bind to the antigenic sites on any Rh-positive erythrocytes that might have entered the mother's blood during delivery and prevent them from inducing antibody synthesis by the mother. The administered antibodies are eventually catabolized.

You may be wondering whether ABO incompatibilities are also a cause of hemolytic disease of the newborn. For example, a woman with type O blood has natural antibodies to both the A and B antigens. If her fetus is type A or B, this theoretically should cause a problem. Fortunately, it usually does not, partly because the A and B antigens are not strongly expressed in fetal erythrocytes and partly because the natural antibodies are of the IgM type, which do not readily cross the placenta.

Hemolytic diseases of the newb
incompatibility of Rh blood groups:

Three conditions in which th
develop antibodies:

A. Blood transfusion before
marriage by blood from Rh+
person.

B. leakage during pregnancy of
small amount of fetal blood
(Rh+) into maternal circulation
(placental hemorrhage).

C. during delivery, same blood
squeezed back to maternal
blood.

In these conditions one of the followings hemolytic diseases may occur:

A. erythroblastosis fetalis (mild disease): small amount of RBC,s leak into mother circulation, some mothers develop antibodies against D antigens. These antibodies pass to fetal blood & cause mild hemolysis of the RBC,s of the fetus.

This newborn baby can be rescued by giving him (Rh-) blood, but not from his mother.

Hemolytic diseases of the newborn because the incompatibility of Rh blood groups:

Three conditions in which the mother may develop antibodies:

A. Blood transfusion before marriage by blood from Rh+ person.

B. leakage during pregnancy of small amount of fetal blood (Rh+) into maternal circulation (placental hemorrhage).

C. during delivery, same blood squeezed back to maternal blood.

B. Icterus graves neonatorum (kernicterus) (moderate disease): the infant is born at term, is jaundiced, or becomes so within 24 hours, there may be severe neurological lesions involving the basal ganglia in which the bile pigments deposited.

C. Hydrops fetalis (severe disease). The hemolysis is severe, the infant may die in uterus or may develop severe anemia, Jaundice & edema; dies within few hours.

Blood Transfusion

Indications of blood transfusion:

1. to restore the Blood Volume,
   e.g. in haemorrhage.
2. to provide Red Blood Cells,
   e.g. anaemias.
3. to increase Blood Coagulability in
   haemorrhagic diseases,
   e.g. haemophilia & purpura.
4. to replace infant's blood with Rh.-ve
   blood in erythroblastosis foetalis.
5. to supply antibodies to raise the
   general resistance of the body.
6. to provide White Blood Cells, e.g. in
   leucopenia (= decreased W.B.Cs).
7. to supply plasma proteins in
   hypoproteinaemia.

Complications of Blood Transfusion

Early	Late
Haemolytic reactions immediate delayed. Reactions due to infected blood Allergic reactions to white cells, Platelets or proteins Circulatory overload Air embolism Citrate toxicity Hyperkalaemia Clotting abnormalities (after massive transfusion	Transmission of disease e.g. hepatitis, malaria, syphilis, AIDS. Transfusional iron overload Immune sensitisation, e.g. to rhesus D antigen

Blood transfusion

Blood for transfusion can be kept for several weeks if it is collected from donors under aseptic conditions into sterile plastic packs containing a suitable preservative solution, and it is stored at 4°C. A commonly used preservative, citrate–phosphate–dextrose (CPD) solution, provides citrate as anticoagulant and glucose (dextrose) as metabolic substrate for the red cells. Adequate numbers (i.e. not less than 70%) of red cells remain viable after transfusion when previously stored in CPD solution for 3–4 weeks at 4°C. Adding adenine to the solution can increase this period to 5 weeks.

The plasma may contain antibodies (agglutinins) against the A and B antigens: anti-A or alpha, anti-B or beta. These agglutinins are not present at birth but they appear between the 2nd and 8th month of life, most probably in response to A and/or B antigens taken in food of animal origin, especially meat, and in some bacteria. The anti-A and anti-B antibodies are described as **naturally occurring antibodies**. In the blood of any individual, the antibody present is the reciprocal of the antigen. Therefore, the ABO sys-

Inheritance of blood group: (Table 2.1)

The inheritance of the A and B antigens is dictated by the A and B genes. The O gene does not produce any demonstrable red cell antigen. This is the reason why group A genotype can be AA (homozygous) or AO (heterozygous). Similarly for group B the possible genotype is BB or BO, while for blood group O the only possible genotype is OO. Group AB has both A and B genes and the only possible genotype is AB. Knowledge of these genotypes is useful in working out the probable blood group of an offspring on the basis of the knowledge of the blood genotypes of the father and mother. It is also helpful in sorting out disputed parentage of the child.

The blood groups

On the surface of human red blood cells are found a series of genetically determined glycoproteins and glycolipids that act as blood group antigens. They appear in early fetal life and remain unchanged throughout life. More than 100 blood antigens have been described, out of which at least 15 well-defined red blood cell group systems exist in most racial groups. Of these, only two are of major importance in clinical medicine—the ABO and rhesus (Rh) systems.

MM, MN, NN, PP,

Pp, Kell, Lewis, Kid,

Lutheran, Duffy and many

others.

The rhesus (Rh) blood group system

The Rh system is described on the basis of the presence or absence of the rhesus antigen (D) on the surface of red blood cells. If present, the individual is said to be D-positive or Rh-positive; 85% of Europeans, 90–95% of Arabs and Africans and 98% of Asians are Rh- or D-positive. If absent, the individual is described as D- or Rh-negative.

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