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ABO Blood Group

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Characteristics

There are four common blood groups in the ABO system: O, A, B, and AB. The blood groups are defined by the presence of specific carbohydrate sugars on the surface of red blood cells, N-acetylgalactosamine for the A antigen, and D-galactose for the B antigen. Both of these sugars are built upon the H antigen—if the H antigen is left unmodified, the resulting blood group is O because neither the A nor the B antigen can attach to the red blood cells.

Individuals will naturally develop antibodies against the ABO antigens they do not have. For example, individuals with blood group A will have anti-B antibodies, and individuals with blood group O will have both anti-A and anti-B. Before a blood transfusion takes place, routine serological testing checks the compatibility of the ABO (and Rh) blood groups. An ABO incompatible blood transfusion can be fatal, due to the highly immunogenic nature of the A and B antigens, and the corresponding strongly hemolytic antibodies (1).

Compared to other blood groups, individuals with blood group O may have a lower risk of pancreatic cancer and thromboembolic disease (2, 3). In addition, in certain African populations, individuals with the blood group O may be protected from life-threatening malaria (4). However, this blood group is not more common in some regions where malaria is endemic. This might be because individuals with blood group O are at higher risk of cholera and severe diarrhea due to *Vibrio cholerae* 01, with individuals with the AB blood group being the most protected (5, 6).

Over 80 *ABO* alleles have been reported. The common alleles include *A1*, *A2*, *B1*, *O1*, *O1v*, and *O2* (7). Whereas the *A* and *B* alleles each encode a specific glycosyl-transferring enzyme, the *O* allele appears to have no function. A single-base deletion in the *O* allele means that individuals with blood group O do not produce either the A or B antigens. Blood type frequencies vary in different racial/ethnic groups. In the US, in Caucasians, the ratio of blood group O, A, B, and AB is 45%, 40%, 11%, and 4% respectively. In Hispanics, the distribution is 57%, 31%, 10%, and 3%; and in Blacks, 50%, 26%, 20%, and 4% (8).

Diagnosis/testing

Serological testing is sufficient to determine an individual's blood type (e.g., blood group A) for the purposes of blood donation and transfusion. Molecular genetic testing can be used to determine an individual's *ABO* genotype (e.g., genotype *AO* or *AA*). This may be useful in the research setting, for example, to investigate the link between ABO blood groups and particular diseases, and also in the forensic setting (9).

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Management

Determining an individual's blood group is important prior to blood transfusion and prior to the donation or receiving of a kidney transplant.

Occasionally, a person's blood type may appear to change. For example, the ABO antigens can act as tumor markers. Their presence may be decreased in particular diseases, such as acute myeloid leukemia, AML (10). In contrast, occasionally the B antigen may be acquired in certain infectious diseases. A bacterial infection with specific strains of *E. coli* or *Clostridium tertium* can generate a B-like antigen from an individual who has the *A1* allele (11).

Genetic counseling

The ABO blood type is inherited in an autosomal codominant fashion. The *A* and *B* alleles are codominant, and the *O* allele is recessive.

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