The Role of Serology in Blood Transfusions

By: Rishima Bolia

Globally, around 118.5 million blood donations occur every year, most of which result in blood transfusions. A blood transfusion is when blood or blood products are received intravenously. However, due to the presence of blood group antibodies and other antibodies in blood plasma, blood must be screened and type-matched before a transfusion. Serological testing is a routine procedure based on antigen-antibody reactions that ensures that the body does not reject transfused blood.

Red blood cells may contain any of 5 glycoprotein antigens – A, B, AB, A1 and H; based on the antigen present on the recipient's red blood cell (RBC), the recipient's blood group is decided. A person who has a certain antigen will also have antibodies acting against the other RBC antigens, as they are considered foreign. Thus, a person who has A and A1 antigens has anti-B antibodies; a person with the B antigen has anti-A antibodies; a person without RBC antigens has both anti-A and anti-B antibodies and a person with both A and B antigens lacks blood group antibodies. Following a transfusion of contradictory blood types, blood group antibodies form complexes with antigens, triggering an immune response and haemolytic reaction in which RBCs are destroyed, which can result in death.

Therefore, serological testing is crucial before blood transfusions can occur. Forward typing is a type of test which detects the presence of A and B antigens on the recipient's RBCs on the basis of agglutination of RBCs. A sample of the blood is individually tested against solutions containing anti-A and anti-B antibodies. If the complementary antigen is present on the RBCs, a complex is formed which causes agglutination or clumping of RBCs. During reverse typing, the recipient's blood plasma is mixed with blood of type A and B separately to determine whether anti-A or anti-B antibodies are present. Both tests must offer the same conclusion before a blood type can be determined and compatible blood can be transfused. The antibodies used in forward typing are called monoclonal antibodies (mAbs).

Cross-matching is another essential aspect of blood transfusions facilitated by serology. This process involves testing the compatibility between the donor's blood and the recipient's blood before the transfusion. Cross-matching helps identify any potential antibodies present in the recipient's blood that could react with the donor's blood cells. Techniques used include indirect antiglobulin test (IAT) and direct antiglobulin test (DAT). The DAT is used to detect immunoglobulins on the surface of RBCs, while the IAT detects red cell antibodies in the serum. Other tests that are performed to ensure that recipients do not reject the blood include antibody screen and antibody identification. Detecting antibodies is crucial in identifying potential risks associated with transfusions, such as hemolytic disease of the newborn (HDN) and transfusion-related acute lung injury (TRALI).

Serology is crucial for the safety and efficiency of blood transfusions, providing valuable information that helps healthcare workers to improve patient outcomes and reduce recipient rejection of blood. Advancements in serology are pivotal in ensuring the safety of millions of blood recipients.

Citations

1. World Health Organisation, Facts In Pictures: Blood Transfusions

https://www.who.int/news-room/fact-sheets/detail/blood-safety-and-availability

2. myDr, Blood Typing

https://mydr.com.au/tests-investigations/blood-typing/

3. Li, Hong-Yang, and Kai Guo. "Blood Group Testing." *Frontiers in medicine* vol. 9 827619. 11 Feb. 2022, doi:10.3389/fmed.2022.827619

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8873177/#:~:text=Serological%20testing%20is%20the%20routine,methods%20cannot%20determine%20blood%20groups

4. News Medical, Monoclonal Antibodies

https://www.news-medical.net/life-sciences/Monoclonal-Antibodies.aspx

5. Lin, J. (2018) 'Clinical applications of direct antiglobulin test,' *Blood, Heart and Circulation*, 2(4). https://doi.org/10.15761/bhc.1000143.

https://www.oatext.com/clinical-applications-of-direct-antiglobulin-test.php#:~:text=The%20DAT%20is%20used%20to,cell%20antibodies%20in%20patient%20serum.