ABO Blood Type Identification and Forensic Science (1900-1960) [1]

By: Harbison, Corey Keywords: Forensics [2]

The use of blood in forensic analysis is a method for identifying individuals suspected of committing some kinds of crimes. Paul Uhlenhuth and Karl Landsteiner, two scientists working separately in Germany in the early twentieth century, showed that there are differences in blood between individuals. Uhlenhuth developed a technique to identify the existence of antibodies, and Landsteiner and his students showed that humans [3] had distinctly different blood types called A, B, AB, and O. Once doctors differentiated blood into distinct types, they could use that information to safely perform blood transfusions. Furthermore, forensic scientists can use that information to exculpate people suspected of some types of crimes, and they can use it to help determine the paternity of children.

When scientists identify blood types, they rely on slight differences in the antigens, or protein markers on the surfaces of red blood cells in a blood sample. In a body, those antigens are recognized and attached to by antibodies. An antibody is a protein in the blood plasma used by the immune system to identify and neutralize bacteria, viruses, and other foreign objects. If antibody proteins detect red blood cells with foreign antigens, they attach to those antigens and cause them to clump. Forensic scientists often use techniques to identify blood types (blood typing) because an individual's blood type isn't affected by disease, drugs, climate, occupation, living conditions, or any other physical circumstances. Additionally, scientists use blood-typing to determine paternity. For example, a parent with an AB-blood type could never have a child with blood type O. If a woman of type-O gives birth to a type-O child, a man with type-AB blood cannot be the father.

In 1901, authorities found the disemboweled and dismembered bodies of two boys in the forests of Rügen, Germany. Police suspected Ludwig Tessnow of murdering the boys, as witnesses had earlier described Tessnow of having suspicious bloodstains on his shirt the day of the murder. To determine the source of the stains on Tessnow's clothing, authorities contacted Paul Uhlenhuth, a professor at the University of Griefswald in Griefswald, Germany. By 1900, researchers at that institution had posited the existence of antibodies and had hypothesized about their relations to other proteins. In 1900, Uhlenhuth had developed a technique to find antibodies. He did so during an experiment in which he had injected a rabbit [4] with chicken [5] egg [6] proteins, extracted serum from the blood of therabbit [4], and then mixed the serum with anegg [6] white so as to be able to study the serum. Uhlenhuth had noted that the original egg [6] proteins would clump, or precipitate out of the solution. Uhlenhuth used his technique to study the stains on Tessnow's shirt. He analyzed the resulting clumps and determined the stains were from human and sheep [7] blood. Tessnow was convicted and executed for the murders and later became infamous as the Mad Carpenter.

In the early 1900s, Karl Landsteiner worked at the Institute of Pathological Anatomy in Vienna, Austria, where he discovered that when he combined blood serum from different individuals, a pattern of antibody-antigen reactions occurred. When blood from one individual was brought into contract with the blood of another individual it clumped up, or agglutinated. Landsteiner initially resigned his observation on agglutination to a footnote in a paper he wrote in 1900, but he expanded upon this observation the following year.

Landsteiner observed a pattern of antigen reactions that occurred when he combined blood serum from different individuals. If blood from what he called the A or the B group was introduced into a host of the opposing group, the host body would trigger an immunological reaction. Landsteiner found that this reaction caused the invading antigen carrying blood cells to burst. Initially, Landsteiner recognized three different blood types: A, B, and C. The C-blood type was later relabeled as type-O, and that type differs from the other groups in that it does not have any antigen marks on its surface.

Blood from the A group formes clumps when mixed with blood from the B group. The red blood cells in O-type blood do not have either A-type or B-type antigens on their surfaces, however O-type blood serum contains anti-A and anti-B antibodies. Because of this property, blood cells from O-type blood do not cause clumping when mixed with A-type or B-type blood. However, if blood cells from A-type or B-type blood are mixed with O-type blood serum, the A and B anti-bodies react, and cause clumping. O-type blood does not possess any antigens that can react with A or B antibodies to trigger an immunological response. Because of that propert, individuals with O-type blood can donate blood to those with any blood type, but they can only safely receive blood from another person with O-type blood.

In 1902, one of Landsteiner's students found a fourth blood type, AB, which triggered a reaction if introduced into either A or B blood. AB-type individuals have A and B antigens on their red blood cells but no anti-A or anti-B antibodies. Therefore, AB-type individuals can safely receive blood from individuals of any blood type, but they cannot safely donate to anyone other than AB-type individuals. Such transfusions could cause blood cells containing the invading antigen to burst and eventually clog capillaries and other small blood vessels, resulting in death. For his discovery of blood groups, Landsteiner received the 1930 Nobel Prize in Physiology or Medicine[8].

Landsteiner's account of blood types brought a new tool to forensic science. For the first time, forensic scientists could definitively compare blood evidence left at a crime scene to the blood of a suspect. Investigators could test whether or not a suspect's blood had the same pattern of clumping reactions as blood left at a crime scene. If not, investigators could exclude a suspect from further investigation. By 1937, scientists had discovered greater than 100 antigens and twenty-three different blood groups based on the presence or absence of those antigens. Due to time for analysis, complexity, and expense of testing for possible reactions among all known antigens, the simpler ABO blood typing system remained the primary method to identify blood. In the mid twentieth century, researchers discovered Rh factor, another antigen present on red blood cells. That factor enabled forensic scientists to better study the blood of suspects and to potentially exclude individuals as the source of blood at crime scenes.

By the 1960s, scientists could use blood typing to exclude individuals as the sources of blood samples, but they could provide only statistical probabilities by which to include individuals as the sources of blood samples. For example, if B-type blood was left at the scene of a crime, a scientist could only say that a suspect with O, A, or AB-type blood did not leave the sample, and that the blood could have come from any member of the population with B-type blood, which constituted ten percent of the overall population. Scientists could use blood-typing, therefore, to help prove innocence, but they could not use it to help identify a suspect beyond a reasonable doubt, the standard necessary for a criminal conviction in many criminal courts.

As blood typing became more common, courts struggled with the issue of whether they had the authority to implement compulsory blood typing in paternity, criminal, and personal injury cases. In the 1891 case *Union Pacific Railroad v. Botsford*, the Supreme Court of the United States in Washington D.C. held that case laws didn't compel individuals to submit to physical examinations, which compulsory blood typing would require, by other parties. Following the Supreme Court's decision, in the 1934 case *Beuschel v. Manowitz*, an appellate court in Brooklyn, New York, reversed a decision of the district's trial court that had ordered a woman and her child to submit to blood group tests. The appellate court reversed the order even though the New York legislature had passed laws to allow compulsory physical exams. In 1935, the New York legislature responded to the *Beuschel v. Manowitz* case by passing a statute that allowed courts to require blood group testing in civil cases. That year, *Flippen v. Meinhold*, a New York City court maintained that it would be improper to draw an inference of paternity where there only existed the possibility of paternity.

As the science behind blood groups became more refined and widespread around the world, the individual states in the US reflected those developments in their laws. They began to pass legislation that allowed courts to order witnesses, in criminal and civil trials, to undergo compulsory blood group testing. Through it continued to be controversial, many forensic scientists used blood group testing until DNA testing, which scientists considered more accurate and reliable, replaced it in the 1980s.

Sources

1. Andrews, Lori B., Maxwell J. Mehlman, Mark A. Rothstein. *Genetics: Ethics, Law and Policy*. St. Paul, MN: West, 2006.
2. Beuschel v. Manowitz, 241 N.Y. 888 (App. Div. 1934).
3. Duran, Joel K. and Monte S. Willis. Forensic Medicine Archives Project. Blood Test.University of Glasgow[9]. http://www.fmap.archives.gla.ac.uk/Case%20Files/Bloodtest/Bloodtest.htm [10] (Accessed September 19, 2015).
4. Flippen v. Meinhold, 156 Misc. 451 (NY Cty. Cts. 1935).
5. "Karl Landsteiner - Biographical". Nobelprize.org. Nobel Media AB 2014. http://www.nobelprize.org/nobel_prizes/medicine/laureates/1930/landsteiner-bio.html [11] (Accessed October 2, 2015).
6. Landsteiner, Karl. "Zur Kenntnis der anti fermentatives, lytischen und agglutinierenden Wirkungen des Blutserums und der Lymphe" [Non-Fermentative, Lytic and Agglutinating Effects of Blood Serum and Lymph]. *Zentralblatt für Bakteriologie* [Primary Journal of Bacteriology] 27 (1900): 357–62.
7. Landsteiner, Karl. "Ueber Agglutinationserscheinungen normalen menschlichen" [Agglutination of Normal Human Blood]. *Wiener Klinische Wochenschrift* [Vienna Clinical Weekly] 14 (1901): 1132–4.
8. Muehlberger, C.W. and Fred E. Inbau. "Scientific and Legal Applications of Blood Grouping Tests."*Journal of Criminal Law and Criminology* 27 (1936): 578–97. http://www.jstor.org/stable/1137503 [12] (Accessed September 19, 2015).
9. Tilstone, William J., Kathleen A. Savage, Leigh A. Clark.*Forensic Science: An Encyclopedia of History, Methods and Techniques*. Santa Barbara, CA: ABC-Clio, 2006.
10. Uhlenhuth, Paul Theodor. *Das biologische Verfahren zur Erkennung und Unterscheidung von Menschen- und Tierblut sowie anderer Eiweisssubstanzen und seine Anwendung in der forensicher Praxis: ausgewählte Sammlung von Arbeiten und Gutachten*. [The biological methods for the detection anddifferentiation [13] of human and animal blood and other protein substances and its application in forensic practice: selected collection of works and reports]. Jena: Fischer, 1905. https://play.google.com/store/books/details?id=POUPAAAAYAAJ&rdid=book-POUPAAAAYAAJ&rdot=1 [14] (Accessed September 28, 2015).
11. Union Pacific Railway Co. v. Botsford, 141 U.S. 250 (1891).https://scholar.google.com/scholar_case?q=Union+Pacific+Railway+Co.+v.+Botsford,&hl=en&as_sdt=806&case=12998230422916570030&scilh=0 [15] (Accessed

May 31, 2016)

The use of blood in forensic analysis is a method for identifying individuals suspected of committing some kinds of crimes. Paul Uhlenhuth and Karl Landsteiner, two scientists working separately in Germany in the early twentieth century, showed that there are differences in blood between individuals. Uhlenhuth developed a technique to identify the existence of antibodies, and Landsteiner and his students showed that humans had distinctly different blood types called A, B, AB, and O. Once doctors differentiated blood into distinct types, they could use that information to safely perform blood transfusions. Furthermore, forensic scientists could use that information to exculpate people suspected of some types of crimes, and they could use it to help determine the paternity of children.

Subject

Blood groups [16] Uhlenhuth, Paul, 1870-1957 [17] Landsteiner, Karl, 1868-1943 [18] Antigen-antibody reactions [19] Biological specimens--Identification [20] Forensic sciences [21] Rugen (Germany) [22] Blood cells [23] Blood transfusions [24] Rh factor [25]

Topic

Theories [26] Legal [27] Technologies [28]

Publisher

Arizona State University. School of Life Sciences. Center for Biology and Society. Embryo Project Encyclopedia.

Rights

Format

Articles [29]

Last Modified

Tuesday, July 3, 2018 - 21:40

DC Date Accessioned

Thursday, June 2, 2016 - 15:41

DC Date Available

Thursday, June 2, 2016 - 15:41

DC Date Created

2016-06-02

DC Date Created Standard

Thursday, June 2, 2016 - 07:00

Links

[1] https://embryo.asu.edu/pages/abo-blood-type-identification-and-forensic-science-1900-1960
[2] https://embryo.asu.edu/keywords/forensics
[3] https://embryo.asu.edu/search?text=humans
[4] https://embryo.asu.edu/search?text=rabbit
[5] https://embryo.asu.edu/search?text=chicken
[6] https://embryo.asu.edu/search?text=egg
[7] https://embryo.asu.edu/search?text=sheep
[8] https://embryo.asu.edu/search?text=Nobel%20Prize%20in%20Physiology%20or%20Medicine
[9] https://embryo.asu.edu/search?text=University%20of%20Glasgow
[10] http://www.fmap.archives.gla.ac.uk/Case%20Files/Bloodtest/Bloodtest.htm
[11] http://www.nobelprize.org/nobel_prizes/medicine/laureates/1930/landsteiner-bio.html

[12] http://www.jstor.org/stable/1137503
[13] https://embryo.asu.edu/search?text=differentiation
[14] https://play.google.com/store/books/details?id=POUPAAAAYAAJ&rdid=book-POUPAAAAYAAJ&rdot=1
[15] https://scholar.google.com/scholar_case?q=Union+Pacific+Railway+Co.+v.+Botsford,&hl=en&as_sdt=806&case=12998230422916570030&scilh=0
[16] https://embryo.asu.edu/library-congress-subject-headings/blood-groups
[17] https://embryo.asu.edu/library-congress-subject-headings/uhlenhuth-paul-1870-1957
[18] https://embryo.asu.edu/library-congress-subject-headings/landsteiner-karl-1868-1943
[19] https://embryo.asu.edu/library-congress-subject-headings/antigen-antibody-reactions
[20] https://embryo.asu.edu/library-congress-subject-headings/biological-specimens-identification
[21] https://embryo.asu.edu/library-congress-subject-headings/forensic-sciences
[22] https://embryo.asu.edu/library-congress-subject-headings/rugen-germany
[23] https://embryo.asu.edu/library-congress-subject-headings/blood-cells
[24] https://embryo.asu.edu/library-congress-subject-headings/blood-transfusions
[25] https://embryo.asu.edu/library-congress-subject-headings/rh-factor
[26] https://embryo.asu.edu/topics/theories
[27] https://embryo.asu.edu/topics/legal
[28] https://embryo.asu.edu/topics/technologies
[29] https://embryo.asu.edu/formats/articles