Journal of Criminal Law and Criminology

Volume 20
Issue 3 *November*

Article 5

Fall 1929

Chances of Establishing Non-Paternity by Blood-Grouping Tests, The

Sanford B. Hooker

William C. Boyd

THE CHANCES OF ESTABLISHING NON-PATERNITY BY BLOOD-GROUPING TESTS

SANFORD B. HOOKER, M. D. and WILLIAM C. BOYD, A. M.[1]

It is now some twenty-five years since the discovery that all human beings may be divided into four groups by means of the inter-agglutination reactions of their bloods. These reactions depend upon the existence of (1) two specific agglutinable substances (A and B) of which one, both, or neither may be present in the red blood cells of a given individual; and (2) two *corresponding* agglutinins (*a* and *b*) of which the other, neither, or both may be present in the plasma or serum. When cells that contain one of these agglutinable substances are mixed with a serum that contains the corresponding (homologous) agglutinin, they no longer remain in even suspension but are rapidly clumped into aggregates which are easily visible through a microscope and often are apparent to the unaided eye. If the serum does not contain the right kind of agglutinin the cells do not exhibit this tendency to stick together and agglutination does not take place.

There are, unfortunately, different designations for the four groups. We shall use the one suggested by Landsteiner who discovered the existence of blood groups. This designation is recommended by the National Research Council and other medical associations; it expresses the cells' content of agglutinable substance—O, A, B, AB. The corresponding sequence of the groups as expressed by Jansky is 1, 2, 3, 4; according to Moss it is 4, 2, 3, 1.

The characteristic group-behavior of human bloods is as follows:

Group O. Cells are inagglutinable; serum agglutinates cells of the other three groups.

Group A. Cells are agglutinated by sera of groups O and B; serum agglutinates cells of groups B and AB.

Group B. Cells are agglutinated by sera of groups O and A; serum agglutinates cells of groups A and AB.

Group AB. Cells are agglutinated by sera of other three groups; serum is not agglutinative.

Many bloods contain other specific substances which do not, however, interfere with this system of grouping. Rarely a blood

[1]From the Evans Memorial, Boston.

is found not to conform exactly to the rules; such exceptions must be remembered in connection with the medico-legal discussion that follows. These instances of anomalous behavior are easily recognized.

In practice, it is a simple and rapid procedure to determine the grouping of an unknown blood. A drop of the blood is suspended in a little saline solution and mixtures of this with authentic, active group A and group B sera are separately prepared. The reactions are completed in a few minutes. By referring to the description of the properties of these sera it may be understood that if the cells agglutinate in neither serum, the individual belongs in group O; if they are agglutinated by B serum but not by A, he is in group A; if just the reverse, he is in group B; and if both sera agglutinate, he is in group AB. For confirmation, the properties of the unknown serum should be examined.

The blood groups are usually determinable at birth and always by the end of two years; once established they are permanent. The relative frequencies of the specific substances vary decidedly in different races; and, of extraordinary interest, these substances are present in the blood of anthropoid apes, but not of the lower monkeys.

Medico-Legal Application

The specific factors are inherited according to Mendelian principles. Numerous investigators in most parts of the world have reported thousands of examples of the transmissibility of these factors from parents to offspring. From the forensic standpoint the important fact thus disclosed is that neither of the dominant factors, A and B, appears in the children unless it is present in one or both of the parents.[2] Thus if a bastard is in group A, his mother in O, and the putative father in O, the latter's innocence is established by the overwhelming mass of evidence which attests the correctness of our understanding of the inheritance mechanism. The few discrepancies reported total but a small fraction of one per cent, have not been verified by thorough reexamination, and may well be ascribed to illegitimacy or to mistakes in technic. Some recent observers, more alertly mindful of these sources of error, have found no non-conformable instances of hereditary transmission.

The practical medico-legal applications of blood-grouping have been mostly confined to the investigation of disputes concerning

[2]The genetic evidence also indicates that the recessive factor O behaves in the same way although the presence of this factor in certain individual phenotypes may not be readily discernible.

paternity, and of the questioned identity of infants in ward nurseries. Our communication deals only with the first of these applications; circumstances have not arisen to indicate any real need of calculating the *probable* usefulness of grouping tests in verifying institutional allocation of the newly born.

The object of the calculations is to determine the probability that the blood groups of the man, the mother, and the child will be such as to show that, according to the laws governing the inheritance of the determining factors, the child could not be descended from the woman *and* man in question, and that consequently, someone else must be its father. The circumstances permitting such a conclusion are exhibited in Table 1.

TABLE 1

Instances allowing the man to establish non-paternity

Man's group	Woman's group	Child's group
O	O	A, B
O	A	B, AB
O	B	A, AB
O	AB	AB
A	O	B
A	A	B, AB
B	O	A
B	B	A, AB
AB	O	O
AB	A	O
AB	B	O

Our calculations are based upon the frequency distribution of blood groups among the white population of the United States and these particular figures are applicable only among peoples whose group percentages are similar. Obviously the method may be used in any country.

The method and abridged calculations will appear in a forthcoming number of the Journal of Immunology.

The results are as follows: The probability that a man incorrectly alleged to be the father of an illegitimate child will be able to establish his innocence by means of blood-grouping tests is 14/100 or 1/7. The chances are 6 to 1 against him.[3]

If, however, the man's group is known the probabilities are distributed as in Table 2.

[3]Since completing this paper we have read that "It is reported that in the run of cases brought before the courts, the decision of the blood groups proves to be final in about 15 per cent." (Popenoe, P.: Jour. Heredity, 1928, 19,436.)

TABLE 2

Probabilities of proving non-paternity when blood group of wrongfully accused man is known.

Group			Per cent	
Landsteiner	Jansky	Moss	in U. S.	Probabilities
O	1	4	45	1/5
A	2	2	42	1/17
B	3	3	10	1/7
AB	4	1	3	1/2
Unknown			100	1/7

The odds against members of group A are great because non-paternity can be established only when the child is in either group B or AB and these are the rare groups; further, children of these two groups are born with unusual infrequency to mothers in group O or A, and, only if the mother is in one of these groups, can evidence of non-paternity be obtained when the alleged father is in group A.

SUMMARY

From the frequency distribution of blood groups and the laws governing their inheritance the relative usefulness of blood-grouping tests in bastardy proceedings has been calculated. The probabilities are given in Table 2.

For general discussion and references to the literature, consult *Snyder, L. H.*: Blood Grouping and its Practical Applications, Arch. Path. and Lab. Med., 1927, *4*, 215-257. *Ottenberg, R.* and *Beres, D.*: The Heredity of the Blood Groups, a chapter in The Newer Knowledge of Bacteriology and Immunology. Ed. by E. O. Jordan and I. S. Falk, Univ. of Chicago Press, 1928. P. 909-920. *Furuhata, T.*: On the Heredity of the Blood Groups. Japan Med. World, 1927, *7*, No. 7. *Snyder, L. H.*: J. A. M. A., 1927, *88*, 562. *Ottenberg, R.*: *Ibid.*, 1921, *77*, 682.