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Bombay blood group: A rare blood group

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REVIEW

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ABSTRACT

Bombay blood group or Hh, is a rare blood group. It is mostly found in south Asia and parts of middle East such as Iran This consists on antigen, the H antigen, this is effectively found on all RBCs. The H antigen is the building block for the production of the antigen within the ABO blood group. Normally, it is believed that the rare blood group is O negative, which is only found in selected people only. But the rarest blood group that is found in any one of millions of people is Hh blood group. This blood group was first discovered in Bombay in India by Dr. Y.M. Bhende in 1952. Anti-H has not been discovered in the ABO group, but it has been detected in the Pre transfusion Test. This H antigen works as a building block in the ABO blood group. The lack of H antigen is known as "Bombay phenotype" or para- Bombay phenotype. The number of H antigens present in body is 1 and the gene name is Fucosyltransferase 1. This blood group is not stored in blood banks because it is rare and its shelf life of blood is 35-42 days.

Key Words
H antigen, Bombay phenotype, Fucosyltransferase 1

Blood Group

The blood group of a person depends on the type of antigen present on the red blood cells. ABO and Rh system of blood groups are most common. Each RBC consists of an antigen on the surface, which can determine to which blood group a person belongs. The ABO blood group was first discovered by Austrian immunologist Karl Landsteiner in 1901.

Bombay Blood Group

It is also called as Hh blood group, which is rare type of blood group. This was discovered by Dr. Y. M. Bhende in 1952, in Mumbai. Phenotypes of this blood grouplacks H antigen on the RBC and the have anti-H in they serum. This type of blood group does not have A, B, or H antigen on the RBC[1].

Biosynthesis of H-Antigen

The H antigen is produced by a specific fucosyltransferase. Based on the persons ABO blood type the H antigen is converted to either A or B or AB antigen. If the person's blood group is O the H antigen remains unmodified. The H antigen is present in high amount in O blood group persons.

Two regions of the genome encode two enzymes with very similar substrate specificities—the H locus (FUT1) and the Se locus (FUT2).

"secretors" (Se/Se or Se/se) contain at least one copy of a functioning enzyme which produce a soluble form of H antigen that is found in saliva and other bodily fluids.

"Non-secretors" (se/se) do not produce soluble H antigen. The enzyme encoded by FUT2 is also involved in the synthesis of antigens of the Lewis blood group.

H antigen expression on red cells is dependent on FUT1 (the H gene).

The FUT2 gene (Secretor gene) is responsible for the formation of the H antigen in secretions (salivary glands) and gastrointestinal/genitourinary tissues. H antigen can be synthesized by H gene (FUT1) and (FUT2) which is located on chromosome 19. The H substance is bio-chemically produced by the binding of Fucose to the surface glycoproteins, the process being catalysed by fucosyltransferase. Blood group A is formed when N-acetyl-galactosamine binds to the H substance. If galactose binds to the H substance, blood group B is formed. If neither substance binds to H, O blood group is the result. Individuals that fail to express H transferase (FUT1) lack the H antigen, which is the foundation of Bombay phenotype.

Phenotype

Common H phenotypes

Secretor (common)

- H antigen is expressed on RBCs.
- H antigen is expressed in saliva.
- No anti-H is produced.
- Genotype: H/H or H/h; Se/Se or Se/se

Non secretor (common)

- H antigen is present on RBCs.
- H antigen is absent from saliva.
- No anti-H is produced.
- Genotype: H/H or H/h; se/se

Uncommon H Phenotypes

- The Bombay phenotype and para-Bombay phenotype are relatively rare.

Bombay phenotype

- H antigen is not expressed on RBCs.
- H antigen is not found in saliva.
- Serum contains anti-H.
- Genotype: h/h se/se

Para-Bombay phenotype

- H antigen is weakly expressed on RBCs.
- H antigen may be present or absent in saliva.
- Serum contains anti-H.
- Genotype: (H), Se/Se or Se/se or se/se+

Para-Bombay phenotype

- Para-Bombay individuals may occasionally have A and B antigens on red cells due to passive adsorption of A and B blood group substances from plasma.
- Based on previous studies, the incidence of the Bombay phenotype in our population ranges from 1:2500 to 1:13,000.
- When compared to the Bombay phenotype, the para-Bombay phenotype is more infrequent, occurring in a ratio of 1:15.
- Para-Bombay individuals can develop anti-H, anti-HI or both in addition to naturally occurring anti-A/anti-B.
- These antibodies have wide thermal amplitude reacting at 4°C, 22°C and 37°C (predominantly at 4°C and 22°C).

Blood Group and Their Interaction

Individuals having Bombay blood group can only receive either autologous blood donation or blood from an individual of Bombay phenotype. It is important to identify it in emergent situations, because any other type of blood being used can have lethal effects on the recipient[2].

Cryopreservation facilities for rare donor units have been recommended. If the blood banks can borrow or exchange rare blood units in times of need, a lot of problems related to rare blood groups like the Bombay blood group can be solved. In the absence of blood donor registry, transfusion management of patients needing immediate surgery can be challenging[3].

Acute Normovolemic Hemodilution (ANH) is a blood conservation technique that entails the removal of blood from a patient shortly after induction of anesthesia, with maintenance of normovolemia using crystalloid and/or colloid replacement. ANH is available, cost effective for suitable patients and reduces blood viscosity[4]. (Table 1)

Clinical Significance

If patients with anti-H in their circulation receive transfusions of blood that contains the H antigen (e.g., blood group O), they are at risk of suffering an acute haemolytic transfusion reaction. The maternal production of anti-H during pregnancy could cause haemolytic disease in a foetus who did not inherit the mother's Bombay phenotype. In practice, cases of HDN caused in this way have not been described, possibly because of the rarity of the Bombay phenotype[5].

Conclusion

The Bombay blood group is a very rare blood group discovered almost 60 years back. It requires proper blood grouping and cross matching of the blood samples. This is a notable case because it emphasizes the importance of proper laboratory investigation for any suspicion of rare blood types as well as identification and management of the Bombay phenotype.

References

1. Joshi SR, Vasantha K. A profile of rare bloods in India and its impact in blood transfusion service. Asian J Transfus Sci. 2012;6(1):42-3. doi: https://doi.org/10.4103/0973-6247.95050
2. Khan M. Bombay Blood Group: A Case Report. The Pacific Journal of Science and Technology 2009 May;10(1):333-7.
3. Roback JD, Grossman BJ, Harris T, et al. Technical manual – American Association of Blood Banks. 17th ed. Bethesda: AABB Press. 2011;744:881-2.
4. Avidan M, Silvergleid A. Surgical blood conservation: Intraoperative hemodilution. In: Kleinman S, Hines R eds. UpToDate, Waltham, MA.
5. Balgir RS. Identification of a rare blood group, "Bombay (Oh) phenotype," in Bhuyan tribe of Northwestern Orissa, India. Indian J Hum Genet 2007;13(3):109-13. doi: https://doi.org/10.4103/0971-6866.38985

Figures and Tables

Table 1: Blood group and there interaction.

Blood Group	Antigen on RBC	Antibody in Serum	Compatible with Blood Group	Incompatible with Blood Group
A	A	Anti-B	A, O	B, AB
B	B	Anti-A	B, O	A, AB
AB	A&B	Neither anti A nor B	A, B, AB, O	-
O	-	Anti A and B	O	A, B, AB
HH	absence of A, B, antigens	presence of anti-A, anti-B and anti-H antibodies	HH	A, B, AB, O