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Review on a rare blood group: Bombay blood

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Abstract
Bombay blood group is the most commonly asked rare blood in India. It is characterized by absence of normal ABH antigens and have been consistent with antibodies in serum. This blood group is suspected when reagent O cells show connection in reverse or back typing or during antibody screening. We present a case of Bombay phenotype which was at the beginning mistyped as O group. At the time of blood grouping, this blood group copy the O blood group due to the absence of H antigen, but it shows inability with O group blood during cross matching. Serum grouping or reverse grouping are necessary for confirmation of the diagnosis. Takes place due to point mutation of the H gene. If the patient bears two mutant gene (H gene), then it will result in Bombay or Oh phenotype. In the field of medical sciences, the Bombay blood group (oh/hh) is a rare develop entity. The blood group has recognizable genotype and phenotype characteristics. This article displays the dynamics involved in the Bombay blood group, presenting its epidemiology, phenotype, genotype, biochemistry distribution, clinical manifestations and management. Most of us are unknowing about such blood groups existence on planet. Bombay blood group is named so because the first case was launch in Bombay (now Mumbai) the financial capital of India. Bombay blood group is very small number of people's people who not have antigen H in their blood and have antigen H as well as do not have B antigen.

Keywords: Bombay blood group, transfusion, whole blood

Introduction
Blood, a connective tissue is certain for human existence. usually it is believe that the rare blood group is O negative, which is very difficult to obtain because of it was found to be in only some selected people on earth. But rather than the O negative blood group there is also one of the rarest blood group which exist on the earth. This blood group was found in only in one of the million people, and its name as Bombay blood group. The Bombay blood group is rare blood group, phenotype of this blood group which has need of the H antigen on the surface of red blood cell membrane and have antigen H in the serum. This types of the blood group is rarest blood group so the main fact is that there is proper blood grouping and proper cross matching is required for safe blood transfer in the individuals.

Fig 1: Whole blood of Bombay group used for intraoperative transfusion

Bombay phenotype is one of the occasional ABO blood groups. The antigens of ABO group (A, B, and H) bearing a complex carbohydrate molecules. The expression of A and B antigens is intent by the presence of H antigen on red blood cells. H antigen can be synthesized by H gene (FUT1) which is present in chromosome 19 and give rise to glycosyltransferase that add L-glucose to a precursor substance to produce H antigen on red cells. H antigen is a necessary substance to A transferase or B transferase which are encoded by the ABO genes located on chromosome 9. Patients carrying this blood group can obtain blood only from a person with this blood group. Bombay blood group is a rare blood group with the occurrence of about 1 in 10,000 in India and 1 in 10^6 in Europe[]. It was first discovered by Dr. Bhende in Bombay, India in 1952. It A and B transferases change H antigen into either A or B antigens, respectively. In group O individuals, the O allele causes an inactive transferase. Therefore, H substance preserve unchanged as group O. Individuals with especially rare Bombay phenotype fail to express H transferase. They can't synthesize A or B antigens, and ABH antigens are absent from their red cells, regardless of their ABO blood group genotype. Since their red cells do not respond with anti-A, anti-B, and anti-AB antiserums, they can be confess as the O blood group in cell typing. Their plasma contains anti-A, anti-B, and strong anti-H which can be hemolytic and is susceptive with all blood types except the Bombay phenotype. As a result, individuals with the Bombay phenotype can only be safely transfused with corresponding blood or other Bombay red cells.

A cross-sectional study manage at Bangabandhu Sheikh Mujib Medical University from January 2020 to June 2021 involved, aseptic collection of 3 ml venous blood sample, with forward and reverse blood grouping revealing a 'O' phenotype. Utilizing anti-H lectin fixed discrepancies and confirmed the absence of 'H' antigen in individuals with Bombay blood groups. Blood samples of Bombay phenotype individuals appeared in the following reactions: anti-A (-), anti-B (-), anti-AB (-), anti-H (-), A cells 4+, B cells. Bombay blood group (BBG) is an especially rare phenotype within ABO blood group system.1 Review of literature reveals that the BBG is reported to be linked with congenital disorder of Glycosylation Type 2C,2 Leukocyte adhesion deficiency type 2,3 and Rambam– Hasharon syndrome.4 So far, no other syndromic associations are described for BBG. The report of first case on an Indian female child, who had a group of clinical findings which contain Bombay blood group, congenital anomalies (Bilateral Microtia with Supra aural fistula), history of mild delay in developmental milestones and repeated infections (Mastoiditis).

Discussion

Bombay phenotype [Oh] was first identified in 1952 by Dr. Y. M. Bhende, in a patient with blood group O, whose blood was incompatible with multiple O group donors on cross matching.1 BBG is extremely rare with an estimated prevalence of 1:10,000 individuals in India and about 1: 1,000,000 persons in other parts of the world.5 In our Blood bank, 47,753 blood groupings have been performed for a period of four years nine months from January 2010 to September 2014 and 9 individuals (four males and five females with a male: female ratio of 0.8: 1) were identified to have Bombay blood group, accounting for a prevalence of 0.02%, which is much higher when compared to literature data which states a prevalence of 0.004% in Tamil Nadu.6 Bombay phenotype is characterized by the lack of H antigen on the Red Blood Cells (RBCs). Since H antigen is the precursor of A and B antigens, these individuals also lack A and B antigens on RBCs. As a consequence, these persons produce Anti-A, Anti-B and Anti-H antibodies. This phenotype is special for the reason that in routine blood grouping it is typed as O group (because of the absence of A and B antigens on red cells), however when cross complement the BBG individual with group O donors, there will be incompatibility (due to the presence of anti – A, anti – B and anti – H in the serum of these individuals which reacts with O cells of donor). The clinical significance of anti H antibodies is that, they can cause acute hemolytic reaction, if the blood from other O group individuals containing H antigen are given and hence. when considering these patients for transfusion, either autologous transfusion or blood from identical Bombay type can only be safely transfused.7 The H antigen has the same wide tissue distribution similar to the A and B antigens. In persons who are "secretors", a soluble form of the H antigen is found in all body fluids excluding the cerebrospinal fluid.5 H antigen is formed by a specific fucosyl transferase (FUT) enzyme, FUT1. RBCs have the H focus which contains the FUT1 gene. At least one normal FUT1 gene should be present on the RBCs for the production of H antigen and consequently, Bombay phenotype occurs if both copies of FUT1 gene are inactive. The Tyr316Ter mutation in the coding region of FUT 1 is the most common cause of classical Bombay phenotype. 8 two cases of native Disorder of Glycosylation Type 2C were reported by Dauber *et al*. with features of autism, short stature, BBG, developmental delay, and recurrent otitis media. Genetic analysis recognize compound heterozygous mutations in the SLC35C1 gene.2 Two children with Leukocyte adhesion deficiency type 2 (LAD 2) with short stature, severe mental retardation, peculiar facies, BBG and imperfect leukocyte motility were reported. The Bombay blood group is a rare blood group, phenotypes of this group lacking H antigen on the red cell membrane and have anti-H in the serum.

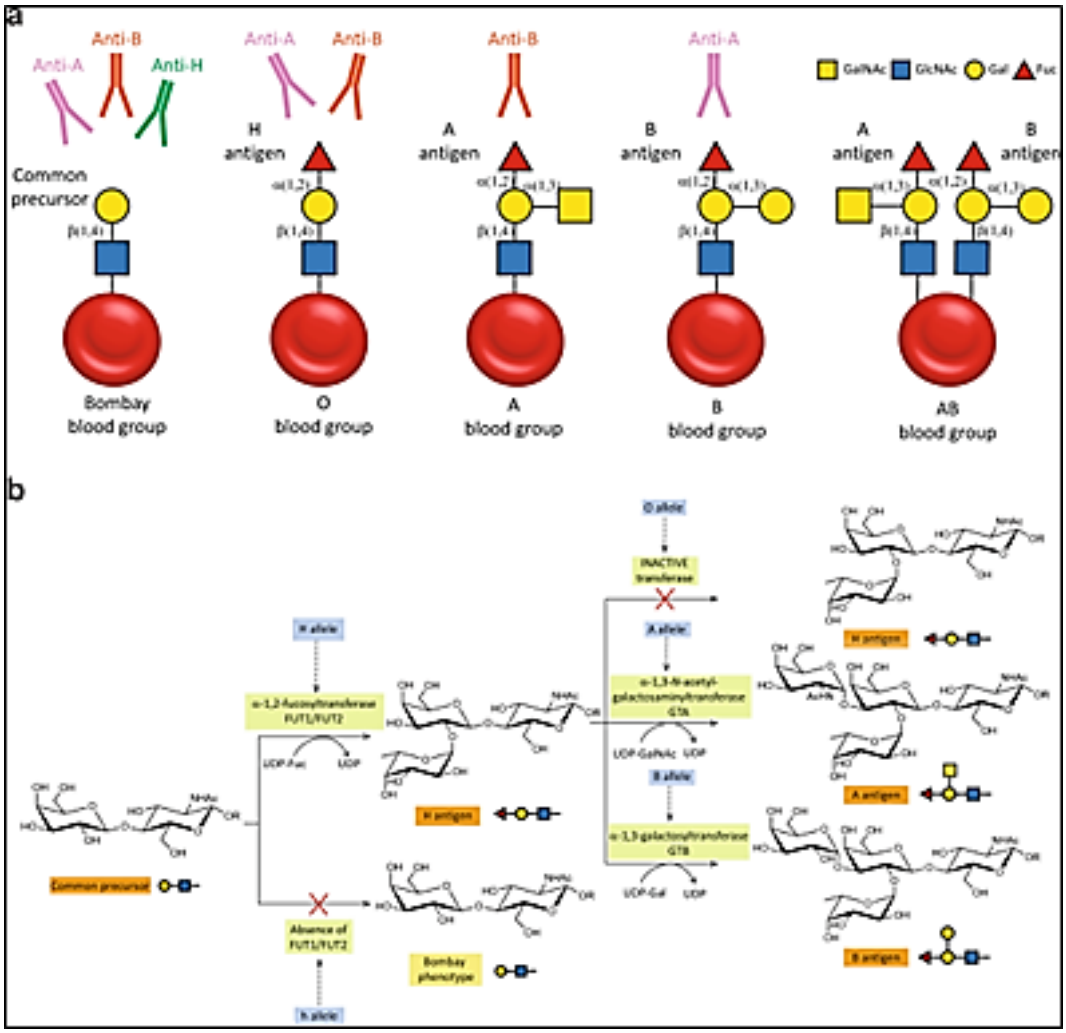

Fig 2: A, B, H, and Bombay antigens in RBCs

Bombay blood group phenotype was first find by the croaker YM Bhende in the time of 1952. This is called Bombay Blood because of it was first set up in the sum of in Bombay. This type of rarest blood type set up in only in the world of 0.0004 percent of the population. It occurs due to the point mutation of the H gene if the case bears two mutant gene, (H Gene) also it will be a result in Bombay or Oh phenotype. Bombay blood group is a rarest blood type. People with this blood type every time show up as type O On a blood test. But they can have hidden DNA for other blood types, which they can pass on to a child. This veritably rare blood type is most common in Southeast Asia. For illustration, around 1 Person in, 000 has this blood type in India. It's important rarer in other corridor of the world. It's literally A 1- in-a-million event in people with European strain! It's so rare that people with this blood Type can't faithfully get a blood transfusion. The Bombay blood group is in fact a rare blood group. All human red blood cells, with exceedingly rare exceptions (Bombay blood group), carry the red cell H antigen. It is present in greatest amount on type O red cells and least on type A1B cells. This H substance is bio-chemically produced by the binding of Fucose to the surface glycoproteins, the process being catalyzed by Fucosyl transferase. If N-Acetyl galactosamine binds to the H substance, it forms the blood group A, whereas if galactose binds to it, it forms the group B. Absence of any obligatory substance to H produces the O blood group. The Bombay phenotype is characterized by mutations or deficiency is Fucosyl transferase.

For confirmation of Bombay blood group, the sample was tested with commercial anti-H lectin (Tulip Diagnostics, India). Tube method was used for this serological test and one drop of anti-H lectin and one drop of 5% red cell suspension were mixed, shaken to homogenize, and then centrifuged and checked for agglutination. There was no reaction and the patient was obey as having Bombay blood group. Indirect antiglobulin technique (IAT) cross-match with O blood group was also done which were 4+ incompatible. His rhesus phenotype was Cde / CDe (R1R1). The extended family study could not be done due non availability of samples from the patient's family members. The patient needed no blood transfusion. The Bombay Blood group occurs in those individuals who have inherited two recessive strains of the H gene. Such individuals do not make the H carbohydrate. As both parents carry the gene to transmit this blood type to their children. In addition, the Bombay Blood has more chances of both parents and the child living of the same blood type. Other examples may be including noble families, which are inbred due to custom rather than local genetic variety.

Bombay phenotype can contribute red blood cells to any member of the ABO blood group system but some other blood factor gene, such as Rhesus is incompatible. They can receive fresh frozen plasma and cryoprecipitate from any group but they can receive red cells only either from autologous blood or from another Bombay individual. In emergencies, they should be supported with plasma or

plasma expanders. It is recommended that individuals with Bombay blood group should get all their family members and relatives tested for the blood group as it is very likely that one or the other relative has this group. A Bombay phenotype individual should always be cautious and alert. They should register themselves with leading blood banks so that in case of emergency they can be contacted. Therefore, every blood bank should maintain a rare donor registry.

Every blood bank can easily maintain a rare blood type donor file from amongst their regular optional donors, If the blood banks can borrow rare blood units in times of need, a lot of problems associated to rare blood groups like the Bombay blood group can be solved. This is only possible if each blood bank has a number of committed regular voluntary donors. Persons with Bombay blood group should get all the family persons and relatives of the patients tested for the blood group. It's very likely that one or other relative has this group. They should also register themselves with leading blood banks or hospitals so that in case of emergency they can be contacted.

The ABO antigens are formed from H antigen by enzymatic action. In Bombay blood group individual, there is no formation of H antigen due to lack of Fucosyl Transferase mediated by H gene. Hence phenotypically, Bombay blood group is identified by the absence of A, B and H antigen on red cells while serum contains anti A, anti B and anti H. Prevalence of Bombay phenotype is 1:10,000 in India. During Forward grouping Bombay blood group is appear as O group because it would not show any interaction with anti A and anti B. shortcut methods (without adding supplementary reagent) can lead to misidentification of blood group. Serum grouping used in O pooled cells helps in identifying Bombay blood group. Body fluids such as saliva, tears, blood etc., except CSF can be used to identify the Bombay blood group by secretary status. Patient having Bombay blood group can collect only blood of Bombay blood group. However, the patient can safely be transfused any fresh frozen plasma (FFP), platelets and cryoprecipitate. Communication by social media helps in avoiding the discard of such rare group blood, as someone somewhere must be waiting for such Bombay blood.

The probability of finding a person with Bombay blood type is 1 for every 2, 50,000 people. India has the highest number of people with the Bombay blood group where there is 1 Bombay blood type per 7,600 people. Geneticists believe that the high number of Bombay blood group people in Indian is the result of consanguineous marriage among [3] members of a caste class. Higher caste class allows consanguineous marriage to maintain their position in the society and to protect their health. Mostly southern, western parts are reported with this phenotype than northern and east of India. Moreover, most of the describe cases were either referred cases or were hospital cases seeking blood transfusions.

Conclusion

Since [1952] Bombay blood group is a rare blood group the individuals having this blood group can receive blood only from an original having similar blood group, so whenever a case of this rare blood group is discovered a pedigree analysis is always helpful to find someone in family with similar blood group as it has been seen in literature and also in this study that family members and first point relatives had Bombay blood group. This study report was published in an intention to create awareness among blood bank medical staffs, technicians and present generation medical students so they will be conscious about rare blood group Bombay O. Thus transfusion reactions to patients can be prevented. A rare blood group the Bombay O when identified in a donor need not be wasted rather can be reserved for another Bombay O group patient.

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