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Original Research Paper

Immunohematology

RARE BLOOD GROUP: BOMBAY PHENOTYPE

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ABSTRACT Occurrence of Bombay blood group is not uncommon in various parts of Rajasthan. If serum grouping is not performed and coombs cross matching not done, it is misdiagnosed as blood group O and hospitals might end up transfusing incompatible blood units to such patients (with O group blood). This study was conducted to determine the prevalence of Bombay blood group amongst the cross match discrepant O blood group patients. Out of the total 7649 cross matches performed during one year, we had 63 such discrepant cases for which we had to perform detailed immuno-haematology work up to obtain compatible blood unit for the given patients' samples. Routine and advanced immunohaematology work was done to determine the blood group and to find the compatible blood unit for transfusion. One sample was found to be having Bombay blood group which belonged to a 19 year old primigravida Muslim female who had presented 38 weeks Amenorrhea and abdominal pain. Reverse blood grouping with O cells and coombs cross match must be adopted by all blood banks. Also, a rare blood type donor file must be maintained in all blood banks.

KEYWORDS : Bombay blood group, Coombs Cross match, Reverse blood grouping, O cells, Anti H lectin.

INTRODUCTION

Karl Landsteiner, the father of Transfusion Medicine, explained about the serious reactions that occurs in human as a result of incompatible transfusion.[1] The daily discovery of numerous blood groups systems and antibody identification developed to ensure the safety and effectiveness of clinical blood transfusion.[2,3] A total of 308 RBC antigens has been recognized till now by the International Society of Blood Transfusion (ISBT), 270 of which are clustered under 30 blood group systems.[4]

Bombay blood group is a rare blood group. If serum grouping is not performed, it is misdiagnosed as blood group O. Therefore both forward and reverse blood grouping should be done on 100% samples.[5]

The first case of Bombay phenotype was first reported in Bombay, India in 1952. In this blood group, no "A" or "B" antigens were identified on red blood cells or in secretions. By definition, that would fit type "O" blood type. In Bombay phenotype, there is absence of A antigen, B Antigen as well as H antigen.[6] It is known that the H antigen is a precursor carbohydrate from which A and B blood groups are formed.

All blood cells, except for Bombay, express the H antigen. People who carry this rare blood type, about 1 in 10000 Indians, can accept blood only from another Bombay blood type individual and not from anyone who is a O, A, B or AB type. These individual lack H gene on their chromosome (homozygous hh) and are non-secretors.[7]

This study was conducted to determine the prevalence of Bombay blood group amongst the cross match discrepant O blood group patients.

MATERIAL AND METHODS

This blood bank based prospective study was conducted over a period of one year i.e., from September 2019 to August 2020 at Blood Bank, Zenana Hospital, Jaipur. Study population included all the cross match discrepancy cases. In the study period, out of the total 7649 cross matches performed, we had 63 such discrepant cases for which we had to perform detailed immuno-haematology work up to obtain compatible blood unit for the given patient's sample.

Blood grouping was done using test tube method. For routine forward grouping, commercially prepared Anti A, Anti B and Anti D antisera (Tulip Diagnostics) were used. For routine reverse grouping, in-house prepared reagent cells (pooled A cell and pooled B cell). For all the O blood group samples, additional reverse grouping with pooled O cells was also performed.

As a part of routine pre-transfusion compatibility work up (cross matching), one unit of blood was cross-matched with patient serum by IAT – column agglutination method. In case, if that showed incompatible cross match with donor O cells, 2 more O positive blood bags were further crossmatched to find compatible blood unit. In case, all 3 units showed incompatibility with patient's serum, patient's serum was tested with pooled O cells. If it showed agglutination, possibility of Bombay/Para-Bombay group or irregular antibodies in patient serum was considered.

As Bombay group is rare entity, so we first went for irregular antibodies screening for irregular antibody screening for which we used 3 cell panel of immucor –Neo Iris. This is a walk away instrument based on SPRCA technique. If it showed negative result for antibody screening, possibility of Bombay/Para-Bombay blood group was considered. For which, we tested patient's RBC suspension with Anti H lectin (Tulip Diagnostics). No agglutination with Anti H lectin indicated possibility of Bombay/Para-Bombay blood group.

Saliva inhibition test was performed on such patient's saliva, a positive reaction on which indicates the absence of A, B and H substances in saliva (i.e., being a non-secretor), confirming the blood group as Bombay and ruling out Para-Bombay and vice verse.

RESULTS

Out of the total 7649 cross matches performed during the study period, 63 cross match discrepancies were encountered during cross match. Out of them, 1 case of Bombay blood group was found on detailed work up, as explained under material and methods section above.

Table – 1 Blood Grouping Results Of Bombay Blood Group Sample

Anti A	Anti B	Anti D	A cell	B cell	O cell
0	0	4+	4+	4+	3+

Table – 2 Tests Performed As Further Work Up

Test Performed	Result
Autocontrol	Negative
DAT	Negative
IAT	3+
Cross match with O+ blood units	3+
Antibody screening (3 cell panel)	Negative
Anti H lectin	Negative
Saliva inhibition test	2+

That blood group sample belonged to a 19 year old Muslim female who had come to Zenana Hospital (Jaipur) Emergency with h/o 38 weeks Amenorrhea (primigravida) and abdominal pain. Vitals were stable on admission. There was no previous history of blood transfusion or any bad obstetric history. Hb was 11gm % and all blood indices were within the range of normal limits. A blood unit was desired to be arranged for this female patients, although she did not require the same and could be managed by the Gynecologist without blood transfusion only.

DISCUSSION

The ***H* gene** is present in more than 99.99% of the random population. Its allele, "h," is quite rare, and the genotype *hh* is extremely rare. The term **Bombay** has been used to refer to the phenotype that lacks normal expression of the ABH antigens because of the inheritance of the *hh* genotype. The *hh* genotype does not elicit the production of α-2-L-fucosyltransferase. Therefore, L-fucose is not added to the type 2 chain, and H substance is not expressed on the RBC. Even though Bombay (*hh*) individuals may inherit *ABO* genes, normal expression, as reflected in the formation of A, B, or H antigens, does not occur.[8,9,10]

	GT Gene		RBC Grouping			Serum Grouping		
			(Forward/ Antigen typing)			(Reverse Grouping)		
ABO TYPE	FUT1	ABO	ANTI A	ANTI B	ANTI H	A_1 RBC	B_1 RBC	O_1 RBC
A_1	+	+	++	0	0	0	+	0
A_2	+	+	+	0	+	+/0	+	0
B	+	+	0	++	0	+	0	0
O	+	0	0	0	++	+	+	0
O_H (Bombay)	0 (hh)	0	0	0	0	+	+	+

The RBCs of the Bombay phenotype (Oh) do not react with the anti-H lectin (*Ulexeuropaeus*), unlike those of the normal group O individual, which react strongly with anti-H lectin.[11,12] Bombay serum contains anti-A, anti-Band anti-H antibodies. Unlike the anti-H found occasionally in the serum of A1 and A1B individuals, the Bombay anti-H can often be potent and reacts strongly at 37°C.

It is an IgM antibody that can bind complement and cause RBC lysis. Transfusing normal group O blood (with the highest concentration of H antigen) to a Bombay recipient (anti-H in the serum) would cause immediate cell lysis. Therefore, only blood from another Bombay individual will be compatible and can be transfused to a Bombay recipient.[13]

It represents the inheritance of a double dose of the *h* gene, producing the very rare genotype hh. As a result, the *ABO* genes cannot be expressed, and ABH antigens cannot be formed, since there is no H antigen made in the Bombay phenotype.

As reported in the another study of Rajasthan conducted by Meghwal et al,[5] occurrence of Bombay blood group is not uncommon among the blood donors of Western Rajasthan. The prevalence of Bombay blood group in their study, in a mixed population covering urban and rural areas of Bikaner district and Western Rajasthan, was reported to be 0.003%.

CONCLUSION

Coombs cross match is a very easy and effective tool to identify rare blood groups/other blood group systems' blood groups also. Every blood bank must adopt coombs cross match for 100% cross match as far as possible.

Since the Bombay Blood Group is very rare blood group, it is desirable to develop cryopreservation facilities for rare donor units. Every blood bank can easily maintain a rare blood type donor file from amongst their regular voluntary donors. 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. This is only possible if each blood bank has a large number of committed regular voluntary donors.

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