

Research Article

Bombay O Blood Donations in Sri Lanka: A Descriptive Study

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Abstract

Background: In addition to the four main groups of the ABO blood group system, a rare phenotype called Bombay O exists. When blood is needed from the Bombay O blood group for a patient, it is challenging for the transfusion service and understanding the prevalence of donors for Bombay O blood group is beneficial.

Objectives: The objectives of this study were to identify the number of Bombay O blood donations in Sri Lanka and determination of the trend in Bombay O blood donation.

Methods: The study was conducted using annual blood collection statistics of the National Blood Transfusion of Sri Lanka, from 2016 to 2024.

Results: Bombay O blood donation remains less than 0.01% of total blood collection in Sri Lanka. Even though there is a rise in total blood donations from 414175 to 454767, there is no increment in Bombay O blood donors. Furthermore, cryopreservation of Bombay O red cells has become increasingly available to maintain an adequate stock of Bombay O blood.

Conclusion: Similar to the other countries in the region, Bombay O blood donations in Sri Lanka are very low, as less than 0.01%. Hence, other strategies must be implemented to manage the patients who need Bombay O blood.

Keywords: ABO blood group system, Blood donation, Bombay O, Cryopreservation, Sri Lanka

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Introduction

The International Society of Blood Transfusion (ISBT) currently recognises 47 blood group systems, comprising 366 red cell antigens [1]. Among those blood group systems, the ABO system is the most important and was the first to be described. Moreover, ABO group compatibility is the fundamental matching criterion in blood transfusion, as almost all individuals have antibodies, anti-A and anti-B, that target A and B antigens, respectively, when they lack antigens [2]. Those antibodies are naturally occurring and cause

immediate intravascular haemolysis in case of incompatible transfusion [3].

There are four main groups in the ABO system: A, B, AB, and O. In addition, the Bombay O phenotype results from the absence of the precursor to the A and B antigens, the H antigen. The presence of two recessive alleles on the H-locus-containing FUT1 gene results in the 'Bombay O' phenotype [4]. This blood group was first described in 1952, in Bombay, India [5]. Like anti-A and anti-B production, individuals of the Bombay blood group have anti-H antibodies against the H antigens, which are most abundant in individuals in

blood group O. Hence, only Bombay O blood group can be transfused to them [4].

The prevalence of the Bombay blood group is very low [6]. Therefore, it is challenging for blood banks to find blood donors when Bombay O blood is needed. Understanding the prevalence of the Bombay O blood group would help ensure a blood supply for patients in need. This study was designed to identify the number of annual Bombay O blood donations in Sri Lanka and to determine the trend in Bombay O blood donations.

Methodology

This descriptive study was conducted from January 2016 to December 2024. All blood donations accepted by the National Blood Transfusion Service of Sri Lanka (NBTS) during the study period were included. NBTS is the sole supplier of blood products for needy patients in Sri Lanka. NBTS is a centralised system, and all blood banks around the country are coordinated by a cluster system. Therefore, all the data, including information on blood collection, are reported to the National Blood Centre monthly. This data is published annually as a statistical report. Hence, data were collected from the NBTS annual statistics reports and analysed as secondary data, which are publicly available at <https://nbts.health.gov.lk/>. All data were de-identified by the source, with all direct and indirect identifiers removed.

The total number of blood donations and the number of Bombay O blood donations were traced from the annual reports. The percentage of Bombay O blood donations for each year was calculated using the collected data.

As Bombay O blood group is rare, when a collected blood unit is not utilised during the shelf life, it is cryopreserved by storing at -30C0 after adding 40% W/V glycerol to extend the shelf life. This allows it to be used for the next ten years, and when a blood unit is needed, it can be thawed from the stock. In addition to blood collection, NBTS also includes the number of frozen Bombay O blood units in its annual report. Therefore, the number of Bombay O blood units cryopreserved annually was also analysed.

Results

From January 2016 to December 2024, a total of 3,875,279 blood units were collected. Of them, 224 were Bombay O blood units, with an average of 0.006% of Bombay O blood donations over 9 years. The annual Bombay O blood collections, together with the total blood collections, are shown in Table 1. Accordingly, the highest and lowest numbers of Bombay O blood units were collected in 2017 and 2016. Though the total number of donations increased over the years, as shown in Table 1, except in 2017, the percentage of Bombay O blood donations among total blood donations remained constant.

Table 1: Number of annual total blood donations and Bombay O blood units

Year	Total blood collections	Number of Bombay O blood units collected	Percentage (%) of Bombay O blood units	Number of Bombay O blood units cryopreserved
2016	414,175	40	0.01	7
2017	423,668	15	0.003	4
2018	450,640	21	0.005	6
2019	444,515	31	0.007	3
2020	397,833	23	0.006	15
2021	385,054	21	0.005	10
2022	442,506	18	0.004	6
2023	462,121	28	0.006	2
2024	454,767	27	0.006	3

Discussion

Bombay O is a rare phenotype in the ABO blood group system. With an average Bombay O collection rate of 0.006% among total blood donations in Sri Lanka, the rarity of the Bombay O is evident. The cryopreservation

of Bombay O red cells has been implemented to address the challenge of blood supply for Bombay O patients.

Individuals with blood group Bombay O have anti-H antibodies in addition to anti-A, anti-B and anti-AB antibodies [4]. When blood typing is performed, both

forward and reverse grouping must be tested [7]. When there is an unexpected reaction in 'O' cells in reverse blood grouping due to Anti-H antibody, it is a discrepancy, and testing with anti-H lectin is essential to identify the Bombay O blood group [4]. As anti-H antibodies can cause immediate intravascular hemolysis, only Bombay O blood can be transfused to patients with blood group Bombay O [5]. Therefore, identifying the prevalence of the Bombay blood group in blood donors is crucial. Increasing donor availability benefits patients by providing blood products.

According to the study, the percentage of Bombay O blood donors in Sri Lanka ranges from 0.003% to 0.01%. Therefore, the prevalence of Bombay O blood donors remains less than 0.01%. This is comparable to other published studies in the region [6,8-10]. A study conducted in South India screened 150,536 blood donors and found a prevalence of 0.004% [8]. Another study tested 35,497 blood donors and found only 3 Bombay O donors, yielding a prevalence of 0.008% [6]. In addition, those researchers have highlighted the consanguinity in individuals with the Bombay O blood group. Research conducted in Iran involving over 7 million blood donors and patients found a prevalence of 0.0008% [9]. Interestingly, they have discovered consanguinity in 50% of individuals with the Bombay O blood group. Hence, it is undeniable that Bombay O blood group is rare in the population, and it is true for Sri Lanka as well.

Because Bombay O donors are rare, it is challenging to find blood for needy patients. Although there are no reported cases with mortality caused by the rarity of Bombay O blood, it could inevitably result in a prolonged hospital stay. To ensure a stable blood supply, it is crucial to maintain a registry of Bombay O blood donors. NBTS also maintains an online registry so that any blood bank in the country can easily access the database to trace blood donors. Generally, family

members of donors are also tested to increase the number of donors of the Bombay blood group.

There are other strategies to manage Bombay O blood stocks. Cryopreservation is an accepted method for maintaining blood stocks for rare blood groups, including the Bombay O blood group [11]. Therefore, improving the availability of such facilities is beneficial. In addition to having blood stocks and donor registries, patient blood management plays a critical role in rare blood group types [12]. Several steps can be taken to minimise the blood usage in such patients. Autologous pre-deposit blood donation is another possibility for Bombay O patients in elective surgical procedures [13]. However, it cannot be performed if the patient is not fit for blood donation before the surgery. Furthermore, acute normovolaemic haemodilution is beneficial for patient blood management in Bombay O patients [14]. Intraoperative cell salvage is also another option for blood management in such cases.

Limitations

This study has several limitations. This study assesses only blood donations, not the requirement or the number of transfusions, as this report relies on data published by the NBTS. Furthermore, among blood donors, there are first-time donors and call-up donors. Results would have been different if only first-time donors were considered. Unavailability of region-wise Bombay O donations is another limitation.

Conclusion

In Sri Lanka, the prevalence of Bombay O donors is very low. Therefore, measures such as cryopreservation of Bombay red cell units and patient blood management strategies are crucial for managing these patients. Further studies are suggested to evaluate the Bombay O blood requirement in Sri Lanka and to describe the available donor pool.

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