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Analysis of discard of blood components and strategies for optimal and safe transfusion practices at a tertiary care hospital blood bank

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Abstract---Blood transfusion service is lifeline of health care system. Blood is a valuable resource so it should be utilized judiciously with minimal wastage. Seropositive donors not only construct some threat of Transfusion-transmissible infections (TTI) such as HIV, HBV and HCV in blood recipient, they also increase the discard in blood bank. This study was conducted to determine discard rate of different blood components, identifying different causes of discarding the blood and its components and to hit upon different approaches to optimize the use of blood. A retrospective cross-sectional study was conducted at the blood bank of tertiary care hospital from September 2015 to October 2021. All collected Blood units were screened for five infections - HIV, HBV, HCV, Syphilis and Malaria and blood units were discarded as per NACO guideline. During study period a total of 8695 donors were donated the blood and screened for TTIs. From all donations, 201(2.31%) were females donors and 8494(97.69%) were males donors. A total 172 seropositive donors were identified among 8695 donors with an overall seroprevalence of 1.98%. Among the seropositive donors 06 were HIV, 71 were HCV and 95 were HBV positive with a seroprevalence of 0.07%, 0.82%, and 1.09%, respectively. During the study period 12597 units were collected and total discarded units were 574 with discard rate of 4.56%. The discard rate of whole blood, PRBC, Platelets and FFP were 3.28 %, 3.70 %, 3.28 %, 3.70 %.

2.61 % and 8.41 % respectively. The maximum numbers of 313(54.53%) units were discarded due to seropositivity, followed by 175(30.49%) units were discarded owing expiry. Proper selection and testing of donor's blood by using standard methods should be done to ensure safety of recipients and early detection of asymptomatic patients. To reduce the wastage of blood and blood products blood bank staffs should identify the different causes of blood wastage in a comprehensive and coordinated way and make policies to eliminate all those factors.

Keywords---blood component, blood transfusion service, discard rate of blood, Seroprevalence

Introduction

Blood transfusion is life-saving intervention of modern medicine and it plays a significant role in different treatment protocols. Globally someone requires blood transfusion in every two second (Blood transfusion safety, 2015). Therefore, blood transfusion service (BTS) is an integral part of health care delivery system (WHO, 2002). The aim of BTS is to provide safe blood /blood components in adequate quantity to meet the patient's need (NACO). Blood can neither be synthesized nor stored for a longer period. The shelf life of RBCs, platelets and fresh frozen plasma are 35-42 days, 4-5 days and 1year respectively (Cancelas et al., 2015; Kaplan, 2012). Blood donation is the only mean by which the blood banks receive blood and provide blood/blood components to patients after proper screening for transfusion transmittable infection and component separation (Khan et al., 2007). World Health Organization (WHO) collected the data of blood donations in different countries which suggested that 87.5 % of developing countries usually collect less than half the blood of their requirements for blood transfusion services to their entire population (Price, 2009). With time requirements of blood and its components have been increasing gradually and to handle this situation more strict guidelines are required for proper utilization of blood. Every unit of blood is valuable and it must be utilized properly. In India blood banks discarded 1.18 million units of blood and blood components during year 2016-2017 (India 60 Tankers Short of Blood, 2016-17). There are various reasons of wastage of blood and its components such as broken bags, broken seal, seropositive units, broken cold chain, clotted blood, expired units and due to lack of proper knowledge, training, and awareness of blood bank staffs.

Discarding seropositive blood is imperative to protect the transfusion recipients from risk of development of Transfusion-Transmissible Infections (TTI) as HIV, HBV, HCV, malaria and syphilis. In 1947 screening of blood donors was started (Red Cross Blood Donation, 2014),and screening of blood donors for HIV, hepatitis B, hepatitis C, syphilis and malaria is mandatory in India to reduce the chance of TTI in blood recipients (Blood bank, 2012; An Action plan for blood safety, 2003). However even after proper screening of blood and its products there is 1% risk of transfusion associated problems including transfusion transmitted diseases among blood recipients (Sunderam, 2015). Screening of blood donors also gives an idea about the prevalence rates of the infections in the community

and help in formulation of long term strategies to improve public health and to prevent spread of disease in local population (Bhawani, 2010; WHO, 2008). The aim of our study is to determine discard rate of blood and blood components, identify the different reasons for discarding blood units in the hospital blood bank and determine the prevalence of seropositivity among blood donors. This can help to formulate proper guidelines for screening of donors, component preparation, storage of blood and its components and judicious usage with minimum wastage.

Materials and Methods

It is a retrospective cross sectional study carried out at blood bank of 690 bedded medical college & hospital in north India. After getting approval from Institutional Ethics Committee, year wise data from September 2015 to October 2021 of all voluntary and replacement donations, seropositive donors, collected units, and discarded units were collected.

In the blood bank serological screening of each donor's blood sample was done for HIV, HBV, HCV, Syphilis and Malaria. Blood was screened by using 4th generation microlisa (J. Mitra & Co. Pvt ltd) kit for HIV, Hepalisa (J. Mitra & Co. Pvt ltd) kit for HBV and 3rd generation microlisa (J. Mitra & Co. Pvt ltd) kit for HCV and results were analyzed using Merilyzer EIAQUANT ELISA machine. Test for Syphilis was done by rapid card test (ASPEN) and malaria parasite by Advantage mal card (J. Mitra & Co. Pvt ltd) and peripheral blood smear examination.

Blood units were discarded due to different reasons by using methods described in standard operating procedures made by blood bank under NACO guidelines (NACO). Discard rate was calculated by using following formula.

Discard rate = total number of blood or components discarded/total number of blood or components prepared $\times$ 100.

Results and Discussions

During study period from September 2015 to October 2021 there were total of 8695 blood donations and all were screened for TTIs. All donations were conducted either at blood bank or at blood camps organized by institutional blood bank at various places. From all donations, 201(2.31%) were females donors and 8494(97.69%) were males. The tally of voluntary donations was 2020(23.23%), out of which 110(1.26%) were females and 1910(21.97%) were males. The major portion of donation was replacement donation, which was 6675(76.77%) comprising of 91(1.05%) females and 6584(75.72%) males (Table- 1).

A total 172 seropositive donors were identified among 8695 donors with an overall seroprevalence of 1.98%. Out of 172 seropositive donors- 06 were HIV, 71 were HCV and 95 were HBV positive with a seroprevalence of 0.07%, 0.82%, and 1.09%, respectively (Table-1). Only 4(2.33%) female donors were identified as seropositive and all had HBV infection. (Figure-1). Fortunately, all our donors were negative for Syphilis and Malaria. A total 6 voluntary donors were seropositive for HBV and 4 for HCV.

During the study period 12597 units were prepared and total discarded units were 574 with discard rate of 4.56%. The maximum blood units were discarded in 2020 with 10.36% discard rate while lowest discard rate 1.97% was observed in 2021.(Figure-2) Among the total collected components, 915 units whole blood (WB), 7756 units Packed RBC (PRBC), 1263 units Platelets and 2663 units were FFP. The discard rate of whole blood, PRBC, Platelets and FFP were 3.28 %(30 units), 3.70 %(287 units), 2.61 %(33 units) and 8.41 %(224 unit) respectively.(Table-2)

The highest number, 313(54.53%) of blood units were discarded due to seropositivity followed by 175(30.49%) units being discarded owing to expiry. The other causes like leakage, clot, hemolysis, discoloration and suboptimal collection account for 75(13.07%) units, 3(0.52%) units, 4(0.7%) units, 1(0.17%) units and 3(0.52%) units respectively. (Table-3).

Blood is precious body fluid and blood transfusion is a life saving treatment modality. Worldwide more than 90 million units of blood are collected per year (WHO, 2015). In ideal setting the wastage of blood or blood products is not permissible in any blood bank but practically it is not feasible due to various reasons like mismatch in demand and supply of blood and blood product, uncertain demands of particular blood group and seropositivity among blood donors. In view of that discarding of blood and blood components in blood bank is permissible in very little quantity (NACO, 2007). To improve accessibility of safe blood for patients and curtail the possibility of TTI, WHO established various strict guidelines for different areas of blood transfusion services, like selection and proper screening of donors, proper documentation, rational use of blood and blood products in hospitals, counseling and treatment of seropositive donors and implementation of effective quality control systems (WHO, 2002).

In this cross-sectional study 8695 donations occurred during study period and similar to other studies majority of the donors were males (97.69%) (Adhikari, 2010; Kakepoto et al., 1996; Stokx et al., 2011; Buseri et al., 2009). A total 172 donors were seropositive with an overall seroprevalence of 1.98%. In our study only 4 female donors (2.33%) were seropositive while remaining 168 (97.67%) were male donors. Like other studies seroprevalence of HBV was 1.09% and it was higher than the seroprevalence of HIV (0.07%) and HCV (0.82%) among donors (Adhikari, 2010; Kakepoto et al., 1996; Stokx et al., 2011; Buseri et al., 2009).

The discard rate of blood units in our study was 4.56% (574/12597) over a period of 6 years. In different studies conducted by (Morish et al., 2012; Kora, 2011; Kumar, 2014; Thakare, 2011; Suresh, 2015; Patil, 2016; Bobde, 2015; Sharma, 2015; Ghaflez, 2014; Deb, 2001) were 2.3%, 4.3%, 8.4%, 3.6%, 7.0%, 22.45%, 6.63%, 8.69%, 12.0%, and 14.61%, respectively.

In our study the discard rate of whole blood was 3.28% (30/915) which was slightly lower than previous studies done by (Suresh, 2015) (5.7%), (Bobde, 2015) (6.63%), and (Sharma, 2015) (4.46%). Expiry was the major reason for discard of whole blood which was 53.33% (16/30) of total wastage followed by TTI positive

units, suboptimal collections and leakage were 30% (9/30), 10% (3/30) and 6.67% (2/30) respectively.

Discard rate for PRBC in the present study was 3.70% (287/7756) which was higher than study conducted by (Bobde, 2015) (2.0%), but comparable to other studies done by (Suresh, 2015) (3.3%), (Sharma, 2015) (3.2%). The most common reason for discard of PRBC was TTI 53.31% (153/287) followed by expiry of units 44.25% (127/287). Other minor reasons of discarding the PRBC like clotting in blood bags 1.04 % (3/287), hemolysis 0.70 % (2/287) and leakage of blood units 0.70 % (2/287) were also identified.

The total discard rate for platelet concentrate was 2.61% (33/1263) which was much lower than (Bobde, 2015) (26.2%), (Ghaflez, 2014) (58.1%), and (Sharma, 2015) (43.6%). It might be due to shortage of other blood transfusion amenities in our neighbouring areas leading to high outflow. Most of the platelet concentrate were discarded due to expiry 96.97 % (32/33) and only one TTI positive was identified during study period.

In our study discard rate of FFP was 8.41% (224/2663) which was greater than (Bobde, 2015) (7.6%) and (Sharma, 2015) (6.2%). TTI positivity 66.67%(150/224) was most common reason for discard of FFP, followed by leakage of units 31.67% (71/224), hemolysis 0.89% (2/224), and discoloration 0.45% (1/224).

Proper utilization of every resource with minimum wastage is the upmost priority in every health care facility. Blood is an invaluable resource and implementation of guidelines of blood transfusion and coordination between hospital and blood bank staff may reduce the wastage of blood and blood components. Donor selection must be based on guidelines described on SOP, deferral of previously screened suspected professional donors and taking proper predonation history reduces the wastage of blood and blood components due to TTI.

The optimal inventory level is adjusted to hospital requirement and daily evaluation of stock of blood and blood products is also necessary. Recruitment of blood donors, blood collection and component separation can be adjusted on the basis of demand from the hospital. Proper maintenance of stock register, keeping the record of collection date and expiry date and follow the first in, first out (FIFO) policy will also reduce the wastage due to expiry.

To improve the performance of technical staff and minimize technical faults leading to wastage of blood components, regular training programmes are obligatory. These training programmes include different prospects of blood transfusion services like standard methods of blood collection, processing and component preparation, proper storage, shifting and transportation.

Standard and calibrated equipments should be used in blood bank for processing of blood components. Centrifugation machine should be equipped with proper monitor and emergency stop button while storage units should also be equipped with electronic temperature monitoring and alarm system. Regular maintenance

and calibration of all equipments is obligatory for proper functioning in blood bank.

Using blood bag with additive solution increases the life span different blood components. SAGM increase the life span of red cells from 35 days to 42 days and platelet additive solution increase the life span of platelets from 5 days to 7 days (Hess, 2006; Chandra, 2014). Putting FFP units in a cardboard or polystyrene protective container during storage and transport and watchful handling of FFP during thawing reduce the wastage due to leakage (WHO, 2009). Regular audit of blood bank by hospital transfusion committee, good communication with the clinicians, preparing platelets on demand and dispatching surplus blood components to other licensed blood centres will also help to reduce the wastage of blood and blood products.

Conclusion

Blood is an important life saving resource and hundred percent utilization of blood product is farfetched. Nearly in all hospitals wastage of blood is an issue of concern and it should be addressed with easy, inexpensive and feasible interventions that can reduce wastage of blood and blood components. Safety of recipients must be ensured by proper donor selection and testing of donor's blood by using standard methods. Screening in blood banks identify asymptomatic patients at an earlier stage where treatment would be more effective and it will also prevent further transmission of infection to the family members and community.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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Tables*Table 1: Yearly blood donations & frequency distribution of seropositive donors*

Years	Donations					Seropositive Donors			
	Voluntary Donations		Replacement Donations		Total Donations	HIV	HCV	HBV	Total Reactive
	Male	Female	Male	Female					
2015	53	12	72	6	143	0	0	0	0
2016	259	21	653	18	951	0	12	12	24
2017	533	38	1101	19	1691	4	10	16	30
2018	359	13	1367	26	1765	1	12	17	30
2019	301	22	1508	20	1851	1	14	20	35
2020	122	2	725	1	850	0	9	15	24
2021	283	2	1158	1	1444	0	14	15	29
Total	1910 (21.97%)	110 (1.26%)	6584 (75.72%)	91 (1.05%)	8695	6 (0.07%)	71 (0.82%)	95 (1.09%)	172 (1.98%)

Table 2: Year wise distribution of prepared blood components and discard rates

Years	Prepared units					Total Discarded units	% of total discarded units
	Whole Blood (WB)	Packed RBC (PRBC)	Platelets	Fresh Frozen Plasma (FFP)	Total Collected units		
2015	73	62	35	5	175	14	8.0%
2016	83	854	90	153	1180	68	5.76%
2017	135	1550	203	264	2152	87	4.04%
2018	202	1594	167	245	2208	118	5.34%
2019	121	1669	517	433	2740	96	3.50%
2020	89	827	79	308	1303	135	10.36%
2021	212	1200	172	1255	2839	56	1.97%
Total	915	7756	1263	2663	12597	574	4.56%

Table 3: Different reasons for discarding blood and blood component

	WB	PRBC	Platelet	FFP	Total
Expired	16(53.33%)	127(44.25%)	32(96.97%)	0	175(30.49%)
Leakage	2(6.67%)	2(0.70%)	0	71(31.67%)	75(13.07%)
TTI	9(30%)	153(53.31%)	1(3.03%)	150(66.96%)	313(54.53%)
Clot	0	3(1.04%)	0	0	3(0.52%)
Hemolysis	0	2(0.70%)	0	2(0.89%)	4(0.7%)

Discoloration	0	0	0	1(0.45%)	1(0.17%)
Suboptimal collection	3(10%)	0	0	0	3(0.52%)
Total Discarded Units	30	287	33	224	574
Total Collected Units	915	7756	1263	2663	12597
Discard rate	3.28%	3.70%	2.61%	8.41%	4.56%

Figures-

Figure 1: Gender wise distribution of seropositive donors

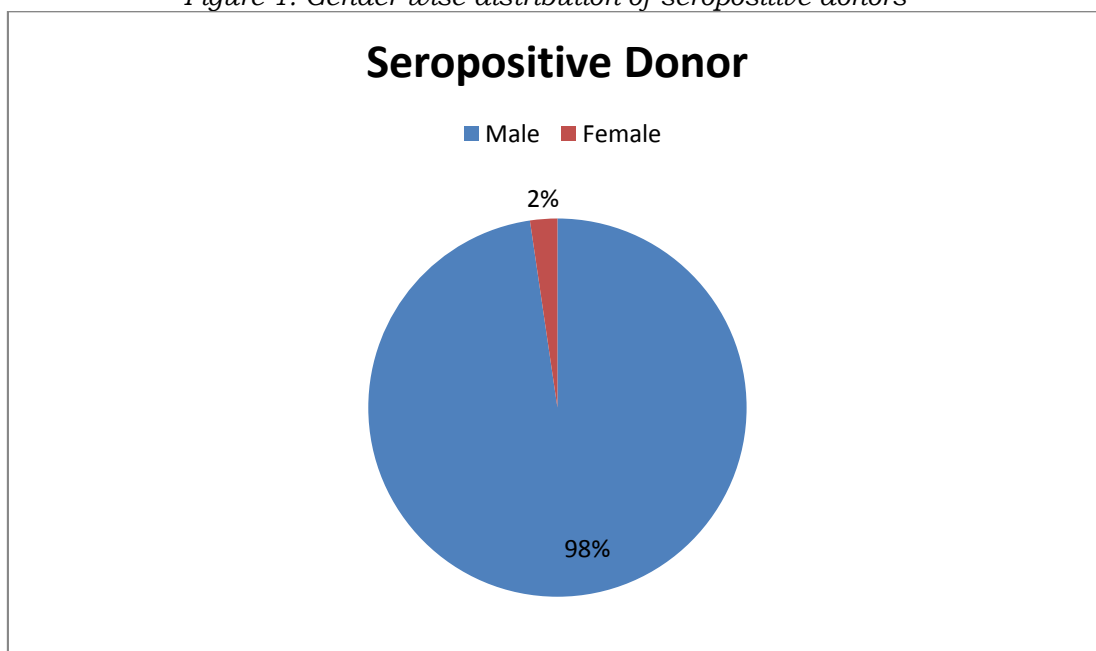


Figure 2: Discard rate of blood components in different years

