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Original Research Article

A Research Analysis of Inevitable Blood Wastage in Blood Bank of a Tertiary Care Teaching Hospital: A Retrospective Study of Five Years

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Abstract

Background: Demand of blood and its components is always more than its supply. It is now high time to develop new operational policies for reducing wastage of blood units.

Aims: The aims of this study were to find the rate of discard and compare the results with other studies and determine the preventive measures for wastage of blood.

Setting and Design: This is a retrospective analytical study conducted over a period of five years from 1st January 2013 to 31st December 2017 in the blood bank of a tertiary care hospital.

Material and Methods: The study included the discard rate of whole blood, packed red cells, platelets, Fresh frozen plasma, cryopoor plasma and cryoprecipitate units due to various reasons.

Statistical Analysis : The collected data were analyzed using descriptive statistical methods and by SPSS version 12.0.

Results: The overall rate of discarded blood and blood components was 5.62%. The rate of discard for CP was the highest at 38.55% followed by PC at 9.18%. The rate of discard for whole blood was 6.18%. The rates of discard for FFP, PRC and CPP were 4.74%, 3.81% and 0.84% respectively. The total discard rate due to reactivity for markers of transfusion-transmissible infection was 3.47 % and 1.02% of the blood components were discarded due to expiry.

Conclusion: To deal with the necessity of blood and blood components more strict measures should be taken and pursued for their right utilization and reduction of wastage.

Keywords: Blood Units; Blood Transfusion Services; Inevitable Wastage; Seroreactive.

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Introduction

Blood transfusion is an integral part of medical practice. It is a vital health care resource used in broad range of hospital procedures [2]. Donated blood is divided into blood components and till date has no substitute. Reducing the amount of discarded blood can contribute towards resources used and decrease the total cost of blood and its components. Discard rate is defined as the proportion of a total number of blood components discarded from the total number of blood collected. When the rate of discarded blood is high, the level of efficiency of collection and components preparation process is low.

Materials and Methods

This is a retrospective analytical study conducted over a period of five years from 1st January 2013 to 31st

December 2017 in the blood bank of tertiary care hospital in Ahmedabad. Ethical clearance for the study was obtained by the institutional review board. A total of 11849 donors eligible to donate blood as per the criteria based on technical manual for transfusion medicine, were included in the study after medical history and brief clinical examination by the medical officer. All the bags collected from these donors were screened for transfusion transmitted infections (TTI)-Human Immunodeficiency Virus (HIV), Hepatitis B surface Antigen (HBsAg), Hepatitis C Virus (HCV), Syphilis and Malarial Parasite (MP). ELISA was performed on a semi automated platform iMark™ Microplate Absorbance Reader (BIORAD) along with PW40/ PW41 Microplate washer (BIORAD). Fourth generation kits for antibodies to HIV-1 (including group O and C) and HIV-2 and HI- 1 p24 antigen (Microlisa-HIV Ag & Ab, J.Mitra), third generation ELISA kits for detecting anti-HCV antibodies (HCV Microlisa, J.Mitra), hepatitis B surface antigen (Monolisa™ HBsAg ULTRA, BIO-RAD) and Treponema pallidum haemagglutination test for syphilis (Immutrep® TPHA, Omega Diagnostics) were used.

Initially reactive samples were retested in duplicate. The samples reactive all three times were considered positive. The samples which were reactive only in first test and nonreactive in any duplicate testing were labeled as false positive, the samples which were reactive in first test and reactive in one of the repeat testing were also considered as positive . Samples which were reactive at any stage and all the blood components derived from it were discarded as per National Biomedical Waste Management policies [11]. Confirmatory testing of reactive donations was undertaken for donor notification, counseling, referral for treatment, deferral or recall for future donation, and look-back on previous donations as per WHO guidelines [9]. Donors found initially reactive were referred to ICTC for HIV and Gastroenterology Clinic & STD Clinic for HBV/HCV & syphilis respectively.

All information was retrieved from the Blood Bank records of the hospital. This included the daily units of blood collection. We analyzed the total blood donation in the form of type of blood donor (whether voluntary or replacement), gender of donor (whether male or female), the number of units of various components prepared and discard rate of whole blood and blood components with reason for discard. The Whole blood was collected as 350 ml or 450 ml in double/triple/quadruple bags with CPDA-1 or additive solution. After blood collection, components were separated within 5- 8 hours. All precautions to avoid red cell contamination were taken such as tapping the segment ends, proper balancing of opposite bags, following standard programs and protocols. The programme of the refrigerated centrifuge was run with mainly two spins-heavy spin (5000 G for 10-15 min) and light spin (1500 G for 5-7 min). Here 'G' is relative centrifugal force calculated using revolutions per minute and rotor length. The study included the discarding of whole blood, packed red cells (PRC), platelet concentrate (PC), Fresh Frozen Plasma (FFP),cryoprecipitates (CP) and cryopoorplasma (CPP) units due to various reasons which included reactivity for TTI, inappropriate blood collection (phlebotomy failure and products that were underweight), hemolysis, bags showing leakages, greenish and yellowish (icterus) discoloration of plasma and clot formation in blood. Blood units which were non-utilized within expiry period of shelf life were also discarded. Quality control was performed on at least 1% of all components produced per month for all parameters to be measured. If less than 100 blood units per month were produced, then at least 4 units were checked. If 75% or more of blood units monitored met specifications then only they were used otherwise they were discarded [3]. The final decision to discard a unit of blood was undertaken only after consulting medical officer at the blood bank. The date and cause of discard were recorded and the unit was disposed off safely according to National Biomedical Waste Management policies [1].

Discard rate was calculated by using formula;

$$\text{Discard rate} = \frac{\text{No. of units discarded}}{\text{No. of units collected (for WB)/Generated by fractionation (for components)}} \times 100$$

The collected data were analyzed using descriptive statistical methods and by SPSS version 12.0.

Results

The data of 11849 donors who donated blood during the study period was analyzed. Among them, 5567(46.98%) were voluntary donors and 6282 were replacement donors (53.02%). 5446 (97.83%) voluntary donors were males and 121 (2.17%) were females. 6235 (99.25%) replacement donors were males and only 47 (0.75%) were females. (Table 1).

Out of total 23,896 units of whole blood and blood components, 4739 in the form of whole blood, 7507 were in the form of PRC, 7004 in the form of FFP, 4325 in the form of PC, 83 in the form of CP and 238 in the form of CPP. The overall rate of discarded blood and blood components was 5.62% (1342 out of 23896). The rate of discard for CP is the highest at 38.55% (32 out of 83) followed by PC at 9.18% (397 out of 4325). The rate of discard for whole blood is 6.18% (393 out of 4739). The rates of discard for FFP, PRC and CPP were 4.74% (332 of 7004), 3.81% (286 of 7507) and 0.84% (2 out of 238), respectively (Table 2).

Out of 293 whole blood bags discarded, 136 (2.87%) were discarded due to low quantity, 127 (2.68%) were discarded due to seroreactivity for TTI, 09 (0.19%) blood

bags were discarded because of expired date whereas leakage and other reasons (hemolysed, icteric & clotted) collectively contributed for 0.44% of discard (Table 3).

Out of the total 1041 blood components discarded, 704 (3.67%) were discarded because of seroreactivity for TTI. After seroreactivity for TTI expiry of blood units because of nonutilization (n = 234, 1.22%) was the second most common cause of discarding followed by leakage from bags (n=71, 0.37%). Low quantity, hemolysed and icteric bags were also the causes for discarding blood units. One donor sample was positive for Direct Coomb's test (DCT) and hence the PCV was discarded. Eight platelets were discarded because the temperature of the platelet agitator was out of range due to electrical fault (Table 4).

The total discard rate due to reactivity for markers of transfusion-transmissible infection was 3.47 % (830 out of 23,896) and 1.02% (243 out of 23,896) of the blood components were discarded due to expiry.

Table 1: Donor category and gender distribution

YEAR	Total donors	Voluntary		Replacement	
		Male	Female	Male	Female
2013	1040	41	1	994	4
2014	1357	91	2	1252	12
2015	2724	699	17	1999	9
2016	3375	1955	21	1397	2
2017	3353	2660	80	593	20
Total	11849	5446	121	6235	47

Table 2: Analysis of discarded units of blood

	Total no. of units	No. of units discarded	Discard rate (%)
Whole blood	**4739**	**293**	**6.18**
Blood components	**19157**	**1041**	**5.43**
PRC	7507	286	3.81
FFP	7004	332	4.74
CP	83	32	38.55
CPP	238	2	0.84
PC	4325	389	8.99
Total	**23896**	**1334**	**5.58**

Table 3: Analysis of discarded whole blood bags

Reason for discard	2013	2014	2015	2016	2017	Total	% discard rate
Seroreactive for TTI	41	49	29	3	5	127	2.68
Low Quantity	11	10	23	50	42	136	2.87
Expired	1	5	3	0	0	9	0.19
Leakage	5	0	0	3	1	9	0.19
Hemolysed	2	2	1	0	0	5	0.11
Icteric	0	3	2	0	0	5	0.11
Clotted	0	1	0	1	0	2	0.04
Total	60	70	58	57	48	293	6.18

Table 4: Reasons for discarding blood components

Reason for discard	PRC	Platelet	FFP	CP	CPP	Total no. of units discarded	Discard rate (%)
Seroreactive for TTI	263	177	261	0	2	703	3.67
Low Quantity	4	3	0	0	0	7	0.04
Expired	6	197	0	31	0	234	1.22
Leakage	2	8	60	1	0	71	0.37
Hemolysed	1	0	1	0	0	2	0.01
Icteric	9	4	10	0	0	23	0.12
DCT Positive	1	0	0	0	0	1	0.01
Total	286	389	332	32	2	1041	5.43

Table 5: Requirements for storage and transport, expiration, and indications of blood and blood components

Components	Storage	Transport	Expiry	Indications
Whole blood	In a blood bank refrigerator at 2 °C to 6 °C	1 °C to 10 °C during transport	35 days in a closed system, 24 h in an open system	Acute blood loss. Exchange transfusion. Massive transfusion.
Packed red cells	In a blood bank refrigerator at 2 °C to 6 °C	1 °C to 10 °C during transport	35 days in a closed system, 24 h in an open system	Chronic, symptomatic anemia. Acute blood loss.
Fresh frozen plasma	In a freezer at below -30 °C	Transported in frozen state	1 year	Multiple factor Deficiencies. Severe liver disease. Warfarin reversal
Platelet concentrate	In a platelet incubator with agitator at 20 °C to 24 °C with continuous gentle agitation	20 °C to 24 °C	5 days in a closed system, 4 h in an open system	Bleeding due to low platelet count or impaired function.
Cryoprecipitate	In a freezer at below -30 °C	Below -30 °C	1 year	Fibrinogen deficiency. Dysfibrinogenemia. Trauma. Disseminated intravascular Coagulation.
Cryopoor plasma	stored at -20°C or lower temperature	Below -20°C	5 years	Thrombotic Thrombocytopenic Purpura (TTP) as well as Hemolytic Uremic Syndrome (HUS).

Discussion

Whole blood is now rarely used for transfusion. Blood component therapy makes clinical sense as most patients require a specific element of blood, such as red cells or platelets, and the dose can then be optimized. Each component is stored under ideal conditions (Table 5). The need for proper component storage is to preserve the biological function of the constituents, decrease their metabolic activities, reduce bacterial growth of the blood components and the use of precious blood donations becomes more efficient.

A total of 23,896 whole blood and blood components units were prepared from 2013 to 2017 in blood bank of our Hospital. Out of these, 5.62% (1342 out of 23896) units were discarded. There were many reasons for the discard mainly seroreactivity for TTI, deviations from established standards during collection such as suboptimal weight at the end of collection, expired units, damaged units, hemolysed, or icteric units.

Cryoprecipitate scored the highest at 38.55% when compared with the other blood components. This was due to non-utilization of the prepared units because of less demand of cryoprecipitate in our hospital. After this finding a strategy was formed that cryoprecipitates were prepared only on demand. After adopting this policy wastage of cryoprecipitate due to non-utilization was not there.

In present study, the discard rate of whole blood was 6.18%. 2.87% of the whole blood bags were discarded due to low quantity. Blood collected in low quantity is unsuitable for transfusion because excess of anticoagulant in underweight blood bags could denature the blood during storage. Low volume of collected blood may be due to several reasons including the discontinuation of donation because of donor's reactions, blood flow from small vein during phlebotomy or duration of the donation exceeds 15 minutes. Selecting a good donor, training and monitoring the staffs will help to reduce cases of the underweight blood units.

Discard rate of platelet concentrate in the present study is 9.18%. A large-scale study conducted in 17 blood centers in 10 European countries from 2000 to 2002 reported that the mean platelet discard rate for 3 years was between 6.7% and 25%. However, the annual mean discard rate from 2000 to 2004 remains at 13% [7] which is comparable with the present study. The discarded platelets included all the platelet units which were expired or seroreactive. Again the reason for expiry was non-utilization of the prepared units due of less demand of platelet concentrate in our hospital. So blood components which are less utilized should be prepared as per their demand to prevent wastage of blood.

The current study showed that the FFP discard rate was 4.74%. The discard rate of FFP was 6.2% in study done by Sharma et. al. [4]. Mishandling of blood bags during

collection, processing, and storage or manufacturing errors is the major cause of defect and leakage of blood bags. The defect and leakage at any part of the plastic blood bags can be detected by visual inspection during processing, after pressure in a plasma extractor, before freezing, and after thawing. The FFP should be stored in cardboard or polystyrene protective containers that minimize the risk of breakage of brittle frozen product during storage, handling, and transportation. Another approach to decrease the leakage and contamination immediately before immersion of the frozen blood bags in the water bath is that the whole container should be placed in a sterile plastic bag.

The discard rate of packed RBCs was 3.81% in the present study. The main reason for discard was due to seroreactivity. In a large-scale study conducted in 17 blood centers in 10 European countries from 2000 to 2002, the mean for packed RBC discard rate was 4.5%, varying annually from 0.2% to 7.7% [8] which is comparable with the present study.

Two units of cryopoor plasma were discarded due to seroreactivity for TTI.

According to Global Status Report on Blood Safety and Availability by WHO [10], reactivity for markers of transfusion-transmissible infection, outdated stock, and incomplete collection were among the main reasons for discard. According to World Bank Income group India is a lower middle-income country. The median total discard rate was 10.9% in lower middle-income countries. Median discard rate due to reactivity for markers of transfusion-transmissible infection for lower middle-income was 5.1% [10].

In present study of five years, total discard rate was 5.58%. Reactivity for markers of transfusion-transmissible infection, expired units and low quantity were among the main reasons for discard. Discard rate due to reactivity for markers of transfusion-transmissible infection was 3.47 %.We also observed that prevalence of voluntary donation increased gradually in the study period, it was 4.04% in 2013 which rose to 81.71% in 2017. Seroreactivity of TTI can be reduced by proper interview of donors and adherence to strict donor screening. Major crisis occurs in summers, heavy short fall in supply encourages the racketing in blood & blood products and develop "professional" donorship. Professional donors come from weaker sections of society and are not in ideal health for blood donation and do it for commercial reasons. Risk of transfusion transmitted infections is also high in blood collected from professional donors. Studies have shown high seropositivity rates of TTIs in replacement donors compared to voluntary donors; a similar finding was noted in our study. The risk of having TTIs in the replacement donors was 1.5 to 2.5 times more when compared with the voluntary donors. This emphasizes the importance of repeat, non-remunerated, regular voluntary donations. In India, the voluntary donations are to the tune of 60-70 per cent, but all are not repeat, non-remunerated, regular voluntary donations. At hospital based blood banks the majority (>90%) of the donors are replacement donors. In such a scenario it becomes difficult to guarantee the safety of blood [5,6]. Fundamental part of preventing TTI is to notify and counsel reactive donors. Nucleic acid testing (NAT) for HIV is being increasingly used in many centers nowadays in addition to Enzyme Linked Immunosorbent Assay (ELISA) which further improves blood safety.

As per WHO report the percentage of donations discarded due to outdate/expiry was 3.1% in lower middle-income [10]. 1.02 % of the blood components were discarded in the present study due to expiry. Appropriate stock management is required to reduce the wastage of blood due to expiry. In our blood bank we follow FIFO system (first in first out), according to this system we arrange the blood units near expiry in front shelves and freezers so that blood units collected first are utilized first to have proper inventory management in blood bank so that they can be used in judicious way and wastage can be reduced.

Demand of blood and its components is always more than its supply. The shortage of blood is 40%. Patients are actually sufferer because the right kind of blood does not reach them in time. It is now high time to develop new operational policies for reducing wastage of blood units without adversely affecting shortages. One policy is double cross-matching, of the same unit of blood for compatibility with two potential recipients (so that it is available for use by either) and also ensures that blood is available for both. Another policy involves using Rh-negative blood for Rh-positive patients under certain conditions, when medically feasible. The long-term archiving of donated serum/plasma samples can be very useful for a Blood Transfusion Services in facilitating the investigation of transfusion-transmitted infections or the evaluation of new screening assays or reagents.

Conclusion

Our study revealed that the discard rate of whole blood bags was 6.0% and the most common component discarded was cryoprecipitate due to non utilization. To deal with the necessity of blood, more strict measures should be taken and pursued for the right utilization of blood and blood components. The performance of Blood Transfusion Services can be increased either by increasing the level of resources used in the collection and production of blood components or by utilizing existing resources more efficiently. Regular audit of transfusion of blood & its components is essential by hospital transfusion committee to reduce wastage of donor blood & to promote rational use of blood.

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Key Message

The performance of Blood Transfusion Services can be increased either by increasing the level of resources used in the collection and production of blood components or by utilizing existing resources more efficiently.

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