academicJournals

Vol. 4(2), pp. 23-28, March 2013
DOI: 10.5897/JPAP2013.0075
ISSN 2141-260X © 2013 Academic Journals
http://www.academicjournals.org/JPAP

Journal of Physiology and Pathophysiology

Full Length Research Paper

A research analysis on blood component usage and wastage in blood bank and blood component center

Manmohan Singhal[1]*, Manish Patel[2], Devesh Kapoor[3] and Dalal Mittal[4]

[1]School of Pharmaceutical Sciences, Jaipur National University, Jaipur, Rajasthan, India.
[2]Dr Dayaram Patel Pharmacy College, Bardoli, Surat, Gujrat, India.
[3]College of Healthcare and Allied Sciences, MJRP University, Jaipur, Rajasthan, India.
[4]ROFEL, Shri GM Bilakhia College of Pharmacy, Vapi, Gujarat, India.

Accepted 3 January 2013

A comparative analysis of blood component usage and wastage was performed in the Nukem Blood Bank and Rotary Suzlon Blood Component Center, Haria L. G. Rotary Hospital (Vapi) during 2007 and 2008. Reasons for wastage of blood components and trends for reducing blood component wastage were analyzed. Questions about the reasons for wastage and the methods for reducing such wastage were created to help the staff of the blood bank to improve utilization of blood. The collection and utilization of blood and its components had a tendency to increase from 2007 to 2008. A great degree of variation in the percent wastage was found, particularly in the Rh -ve blood type, leading to increase of non availability as well as discarded due to expiry. The most frequent reason for wastage was breakage and red blood cells (RBC) contamination (for fresh frozen plasma (FFP)) and expiry (for PC and packed red blood cell (pRBCs)). The most encountered reasons for utilization were anemia, thrombocytopenia (especially for platelet concentrate (PC)), surgery, accidental injury and hepatitis (especially FFP). Blood and its components are very important resources due to shortage. A proper inventory management system and up gradation of facilities and training of staff is necessary to ensure optimum utilization and minimize wastage.

Key words: Blood, hematocrit, packed red blood cells, transfusion, Nukem blood bank.

INTRODUCTION

Blood is a specialized bodily fluid that delivers necessary substances to the body's cells, such as nutrients and oxygen and transports waste products away from these same cells.

Blood must be collected into single-use, sterile, FDA-licensed containers (Rubin and Ness, 1989). The blood should be drawn from an area free of skin lesions, and the phlebotomy site should be properly decontaminated. The site is scrubbed with a soap solution, followed by the application of tincture of iodine or iodophor complex solution. The selection of the venipuncture site and its decontamination are important steps, because bacterial contamination of blood can be a serious or even fatal complication of transfusion (Sazama, 1990; Morduchowicz et al., 1991).

Blood components can be obtained by aphaeresis rather than prepared from a standard unit of whole blood (Abdul-Rahman, 2009). All of these instruments use centrifugation to separate the blood components (Ranganathan et al., 2008). Human plasma is a source of important medicinal products which are obtained by a combination of large-scale processing steps called“fractionation” as shown in Figure 1.

*Corresponding author. E-mail: manu_mpharm@yahoo.co.in. Tel: +91-9829153193.

Indication for blood transfusion

Red blood cells (RBC)

One unit of packed RBC (pRBC) in an adult will increase hematocrit (Hct) approximately to 3% and hemoglobin (Hgb) by 1 g/dl.

Indication; Patient is actively bleeding (Goodnough and Bach, 2001; Hebert et al., 1999): (1) Hct < 21%; (2) Hct < 24% in patient with coronary artery disease, unstable angina, myocardial infarction, or cardiogenic shock; (3) Rapid blood loss > 1.5 to 2 L; not responding to volume resuscitation; (4) Autologous RBC: Hct < 27%.

Platelets

A single dose (adult: aphaeresis of 6 concentrates; pediatrics dose: 1 units/10 kg) will increase the platelet count by 25-35 × 10^9 L^{-1}.

Indication; Platelet count ≤ 10 × 10^9 L^{-1} prophylactic in a patient with failure of platelet production; Platelet count ≤ 20 × 10^9 L^{-1} and signs of hemorrhagic diathesis (petechia, mucosal bleeding); Platelet count > 50 × 10^9 L^{-1} (Goodnough and Bach, 2001; Hebert et al., 1999).

Transfusion-transmitted infections

The risk of bacterial infection has emerged as the major cause of transfusion related morbidity and mortality, in part due to the reduction of other risks (Andreu et al., 2002; Wagner, 2004; Hillyer et al., 2003). Bacterial contamination is more frequent in platelet concentrates (PLT) than in red blood components most likely because many microorganisms can survive and propagate under the storage conditions typically used for PLT (20 to 24°C), but less than so for RBC (1 to 6°C) (Hillyer et al., 2003; Blajchman et al., 2004).

Like bacterial infections, the risk of viral infection has emerged as the major cause of transfusion related morbidity and mortality like human immunodeficiency virus (HIV), hepatitis C virus (HCV), hepatitis B virus (HBV), etc.

Improvements in blood safety occurred at a time of the public increased fear of transfusion and the more cautious use of blood components by physicians. The steps in donor selection and laboratory testing described have resulted in the nation's blood supply being safer than ever (Busch et al., 1991; Donahue et al., 1992). The introduction of new tests for transmissible diseases has further reduced the proportion of infectious donors. Screening of the donor's identity against donor deferral registries detects individuals who previously were deferred as blood donors, but who for various reasons attempt to donate again. These and many other changes have resulted in improved blood safety. The risk of acquiring a transfusion-transmitted disease ranges from 1 per 150,000 U for hepatitis B to 1 per 2,135,000 U for HIV (Lackritz et al., 1995; Schreiber et al., 1996).

MATERIALS AND METHODS

It is a retrospective study in which data relating to collection and usage of blood and its component from January 2007 to December 2008 at Haria L. G. Rotary Hospital's Nukem Blood Bank and Rotary Suzlon Blood Component Center, Vapi was collected and analyzed.

Data collection and analysis

Data for last 2 years were collected from the database at Nukem Blood Bank and Rotary Suzlon Blood Component Center of Haria L. G. Rotary Hospital, Vapi. Microsoft access was used for generation of database and analysis. Data regarding donation, issue and discard of blood and its components were collected month wise for 24 months starting from January, 2007 to December, 2008.

Collected data was processed and categorized as follows: (1) Comparative utilization of components; (2) reasons for usage (issue) of blood components; (3) reasons for wastage (discard) of blood components.

After analysis and review of the aforementioned data, suggestion was generated with the help of the staff of blood bank and hospital to improve utilization of blood and blood components. The percentage discard was calculated by the following formula:

$$\text{Percentage of discard} = \frac{\text{Number of unit discarded}}{\text{Number of units collected (WB)/Generated by fractionation (For blood components)}} \times 100$$

RESULTS

Comparative usage of different components of blood

Here, the total utilization of different components and whole blood (WB) was compared for the entire period (November, 2007 to December, 2008). The highest number of units issued was for WB. Among the various components, pRBCs was the maximum utilized followed by fresh frozen plasma (FFP) and platelet concentrate (PC) as shown in Figure 2.

Comparative wastage of different blood components

Here, the total wastage of different components and WB

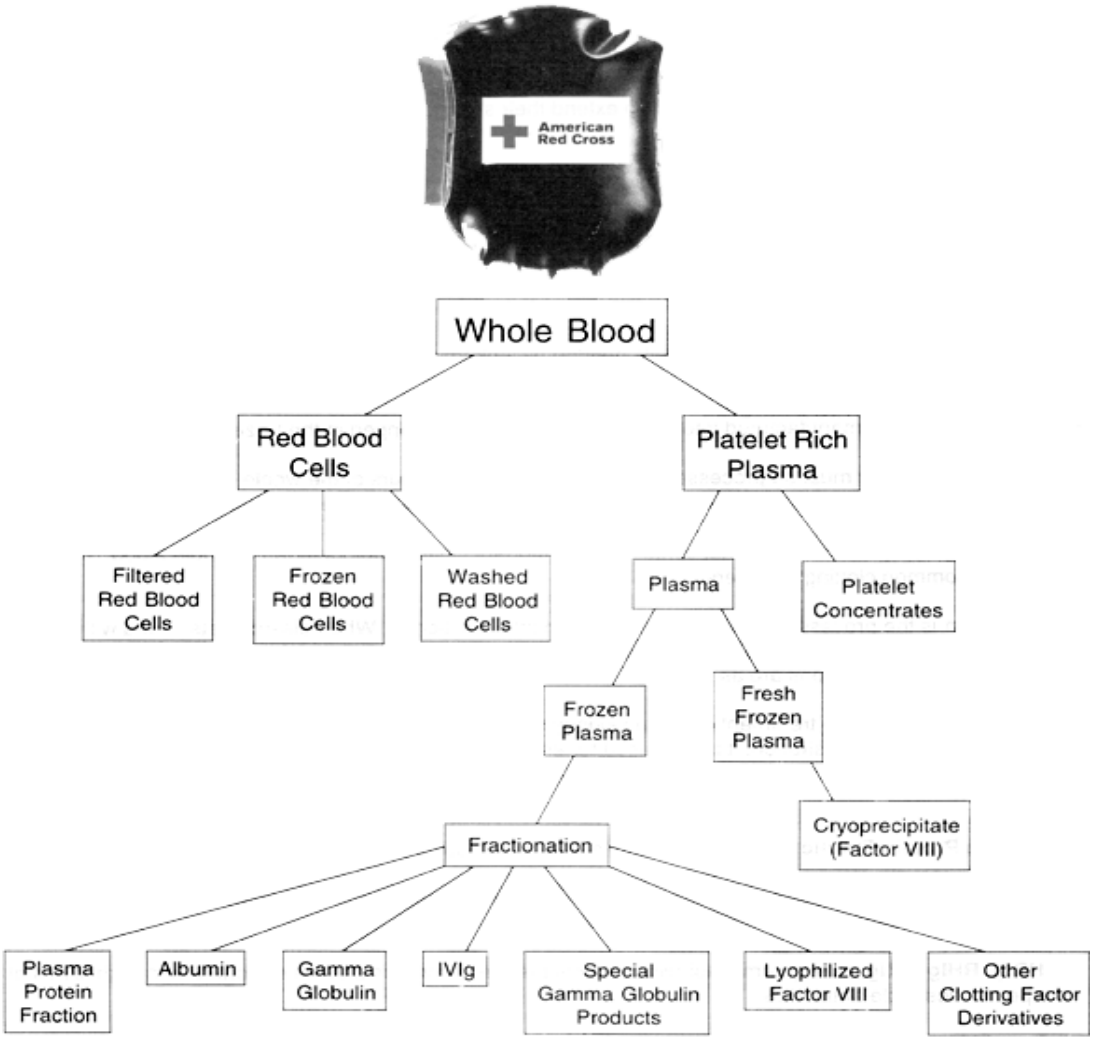

Figure 1. Fractionations of blood components from whole blood.

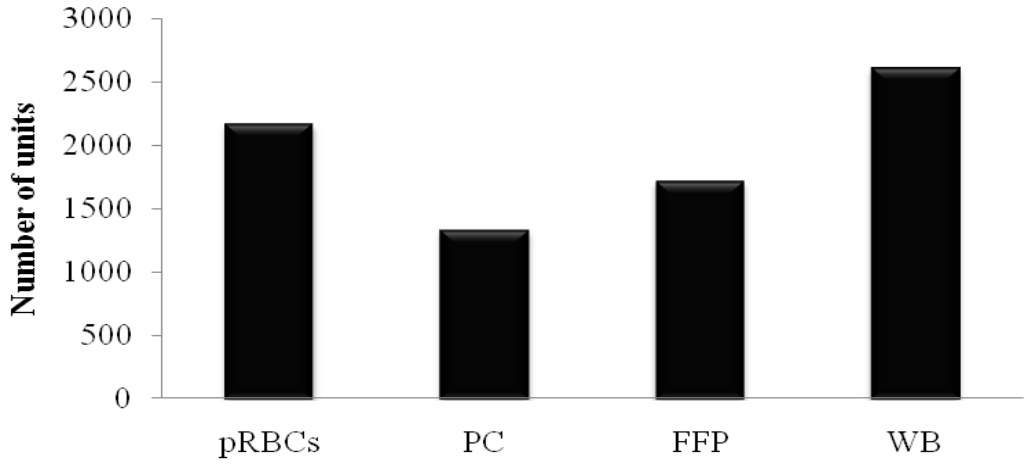

Figure 2. Comparative usage of different components of blood.

Table 1. Comparative wastage of different blood components.

Component	Unit
pRBCs	2161
PC	1319
FFP	1709
WB	2603

Table 2. Reasons for utilization of blood components.

Reason of usage	pRBCs	FFP	PC	WB
Anaemia	1471	526	220	2822
Accident	50	40	1	204
Thalassemia	58	0	1	26
Thrombocytopenia	61	290	751	48
Dialysis	22	0	2	102
Surgery	37	20	7	250
Burns	1	7	0	19
Injury	2	0	0	25
Bleeding	15	19	0	85
Sickle cell anaemia	11	2	1	6
Hepatitis	5	69	7	9
RTA	7	17	6	53
Not recorded	26	77	5	85
Others	393	649	318	2297

Table 3. Wastage of different components according to reasons.

Reason of discard	pRBCs	PC	FFP	WB
Breakage	6	6	160	4
Expiry	47	424	20	105
HBsAg +ve	25	22	35	56
High lipid	1	13	48	5
High bilirubin	18	14	22	4
HIV +ve	5	6	5	11
HCV +ve	0	0	0	17
Leakage	1	1	2	1
RBC contamination	0	14	33	2
QNS	1	4	3	122
Others	6	13	13	16

was compared for the entire period (November, 2007 to December, 2008). The maximum wastage was found to be for PC, followed by FFP and pRBCs. Wastage of WB was more than pRBCs; however, less than PC and FFP as shown in Table 1.

Reasons for usage of blood components

Table 2 shows the reason for utilization of pRBCs, WB, FFP and PC. pRBCs was mainly utilized for anemia followed by thrombocytopenia, thalassemia, accident and

surgery. The major reason for usage of FFP was anaemia followed by thrombocytopenia, hepatitis and accident. The most common reason for use of PC was thrombocytopenia followed by anaemia. The major reason for usage of WB was anaemia followed by surgery, accident, dialysis and bleeding.

Reasons for wastage (discard) of blood components

Table 3 shows the reason for wastage of different blood components: pRBCs, WB, FFP and PC. The major reason for discard of pRBCs was expiry followed by +ve detection of HBsAg and high bilirubin content. The most common reason for discard of FFP is breakage followed by high lipid, RBC contamination, HBsAg +ve and high bilirubin. The maximum numbers of PC units discarded are due to expiry (82.01%), followed by HBsAg +ve, high bilirubin and high lipid content. The main reason for discard of WB was quantity not sufficient (QNS), expiry, detection of HBsAg +ve and HCV +ve.

DISCUSSION

At the site of study (the Nukem blood bank), even after the short of fractionation, WB was used many a times. A comparison of the number of units issued during November, 2007 to December, 2008, indicates that among the components, pRBCs was the most utilized, followed by FFP and PC. Since the practice here involves an option of storing blood in the form of WB or fractionating in to either by pRBCs and FFP or by pRBCs, PC and FFP. Accurate inventory and analysis of utilization of different components would be useful in the deciding on mode of fractionation. An analysis of the wastage of different blood components showed that a lot of units of PC were discarded; this could be due to a very short expiry period. A higher demand coupled with a longer expiry period (relative to PC) might have caused the discarded rate of pRBCs to be the lowest. On the other hand, despite the longest expiry, the lower utilization leads to a higher discarded for FFP. This was found to be coupled with other technical reasons like breakage, RBC contamination, etc.

The major reason for wastage of different components was found to very dependent on the pattern of its utilization, shortage and individual characteristics. Expiry was the major reason for discard of PC and pRBCs, whereas technical faults like breakage and RBC contamination were the most common reasons for discard of FFP. On reviewing with staff of the blood bank, it was identified that a modified and larger shortage setup along with more trained and equipped staff could minimize breakage and other technical faults leading to wastage of FFP. A surprisingly large number of cases were found to be HBsAg +ve. With more careful screening and awareness program, the donors and staff could help to minimize this. Another reason for discard was detection of high bilirubin and high lipid content. This additional practice followed here, which although increases discard rates would be beneficial to the patients receiving the blood or its component.

As far as utilization is concerned, the most common reason for WB or components was found to be anemia for hereditary anemia like thalassemia and sickle cell anemia, mostly pRBCs were used. Most common indication for PC was thrombocytopenia. The utilization of PC other than thrombocytopenia and anemia was very rare. The use of FFP was for anemia, thrombocytopenia and hepatitis (probably to maintain protein and blood volume). Besides anemia, the use of WB was for surgery, accidental cases and patients suffering from hemorrhage or undergoing dialysis. There were many instances where the reason for use was not specified. In many of these, the blood was issued to other hospitals.

After analysis of the available data, review of the staff and facilities at the blood bank and discussions with the concerned staff, the following suggestions were generated to optimize utilization of blood and its components:

(1) Up gradation of storage and other facilities at the bank to deal with more inventories.
(2) A software based system for monitoring stock and predicting utilization.
(3) Using the aforementioned information to screen donors for collection of optimum amount of blood of required blood groups.
(4) Generating a list of donors to be used in cases of shortage, to avoid instances of non-availability (the existing practice of replacement if possible to be continued).
(5) To record instances of denial because of non-availability and ensure appropriate entry of all information regarding collection, utilization and wastage.
(6) Continual education programs to improve performance of related staff.
(7) Use of more advanced materials to increase expiry of pRBCs and PC.

Conclusion

Blood and its components are a very important resource and hence should be used in a justifiable manner. The pattern of utilization and wastage is different from other reports of monitoring of blood and its components, as the blood bank is attached to the hospital. This helps in minimizing wastage by case of reallocation of reserved but unutilized blood components. A proper inventory management system with accurate and timely database formation is necessary to minimize wastage. There is an

increase in utilization of blood and blood components from year 2007 to 2008. However, there is a lot of variation in usage/wastage over the same period.

REFERENCES

Abdul-Rahman IS (2009). Renal disease in hematological malignancies. Hong Kong J. Nephrol. 13(1):5-18.

Andreu G, Morel P, Forestier F, Debeir J, Rebibo D, Janvier G, Herve P (2002). Hemovigilance network in France: organization and analysis of immediate transfusion incident reports from 1994 to 1998. Transfusion 42(10):1356-1364.

Blajchman MA, Goldman M, Baeza F (2004). Improving the bacteriological safety of platelet transfusions. Transfus. Med. Rev. 18(1):11-24.

Busch MP, Young MJ, Samson SM, Mosley JW, Ward JW, Perkins HA (1991). Risk of human immunodeficiency virus (HIV) transmission by blood transfusions before the implementation of HIV-1 antibody screening. Transfusion 31:4-11.

Donahue JG, Munoz A, Ness PM (1992). The declining risk of post-transfusion hepatitis C virus infection. N. Engl. J. Med. 327:369–373.

Goodnough LT, Bach RG (2001). Aneamia transfusion and mortality. N. Engl. J. Med. 345:1272-1274.

Hebert PC, wells G, Blajchman MA, Marshall J, Martin C, Pagliarello G, Tweeddale M, Schweitzer I, Yetisir E (1999). A multicenter, randomized, controlled clinical trial of transfusion requirement in critical care. N. Engl. J. Med. 340:409-417.

Hillyer CD, Josephson CD, Blajchman MA, Vostal JG, Epstein JS, Goodman JL (2003). Bacterial contamination of blood components: risks, strategies, and regulation: joint ASH and AABB educational session in transfusion medicine. Hematol. 2003:575-589.

Lackritz EM, Satten GA, Aberle-Grasse J (1995). Estimated risk of transmission of the human immunodeficiency virus by screened blood in the United States. N. Engl. J. Med. 333:1721-1725.

Morduchowicz G, Pitlik SD, Huminer D, Alkan M, Drucker M, Rosenfeld JB, Block CS (1991). Transfusion reactions due to bacterial contamination of blood and blood products. Rev. Infect. Dis. 13:307-314.

Ranganathan S, Sesikeran S, Gupta V, Vanajakshi (2008). Emergency therapeutic leukapheresis in a case of acute myeloid leukemia M5. Asian J. Transfus. Sci. 2(1):18-19.

Rubin RJ, Ness PM (1989). What price progress? An update on vinyl plastic blood bags. Transfusion 29(4):358-361.

Schreiber GB, Busch MP, Kleinman SH, Korelitz JJ (1996). The risk of transfusion-transmitted viral infections. N. Engl. J. Med. 334:1685-1690.

Sazama K (1990). Reports of 355 transfusion-associated deaths: 1976 through 1985. Transfusion 30:583-590.

Wagner SJ (2004). Transfusion-transmitted bacterial infection: risks, sources and interventions. Vox Sang. 86(3):157-163.