USE OF BLOOD AND BLOOD COMPONENTS IN DHAKA MEDICAL COLLEGE HOSPITAL

FAHMIDA SHARMIN CHOWDHURY [1], MD. ALI EHSAN SIDDIQUI[2], KHAIRUL ISLAM[3], ZUBAIDA NASREEN[4], HUSNE ARA BEGUM[5], HOSNE ARA BEGUM[6]

Abstract

Introduction: *Use of blood means providing the right blood product, in the right quantity, for the right patient. It can help in bridging the gap between demand and supply of the precious blood or blood products.*

Objective: *The present study was designed to study appropriateness of use of the blood components in different wards in DMCH, to improve the consistency and appropriateness of transfusion practice, to promote the integration of quality management systems into transfusion practice, to reduce the overall number of transfusion-related complications, to increase consumer awareness of the benefits and risks of blood component therapy; and conserve a limited resource.*

Methodology: *This study was done at Transfusion Medicine Department of Dhaka Medical College Hospital in the period between January 2008 to December 2011. Donors of 18 to 55 years of both sexes were selected after reviewing the questionnaire, physical and medical examination and written consent .Blood was collected in different blood bags. Blood components were prepared by centrifugation of whole blood in a refrigerated centrifuge machine. Data was collected using a pre-tested questionnaire on age, gender, department, haemoglobin levels, indications of blood transfusions, types of product advised, total number of units ordered, cross-matched and transfused. Rational use of blood was assessed by determining prevalence of appropriateness using World Health Organisation's clinical practical guidelines and transfusion indices. Interviews were done with doctors to assess their knowledge and practices.*

Result: *In 2008, 1231(8.4%) components were prepared against 14560 whole blood. In 2009, 1636 (9.63%) components against 16984 whole blood were prepared. In 2010, 1380 (8.13%) components were prepared against 16980 whole blood. In 2011 1800 (8.91%) components were prepared and supplied to surgery, medicine, gynae, paediatrics, haematology and oncology wards.*

Conclusion: *The hospital was not rationale in use of blood.*

Key words: *Components therapy, RCC, FFP, PRP, PC, Cryoprecipitate.*

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Introduction

All patients requiring transfusion should have reliable access to safe blood products, including whole blood, labile blood components and plasma-derived medicinal products, appropriate to their clinical needs, provided in time and safely administered. Data on the use of blood products are limited, but studies suggest that blood products are often overprescribed in both developed and developing countries.[1]

This is the separation of whole blood into its individual components to optimize individual therapeutic potency based on sound physiologic principles and understanding of the relative risks and benefits of each transfusion.[2]

Component therapy introduced within 1950's-1960. This therapy involves administering only the component needed, i,e. the "minimum for the

1. Asso. prof. Transfusion Medicine, NIKDU, Dhaka
2. Consultant, Cardiology, NITOR, Dhaka
3. Asst. Prof. Transfusion Medicine, NITOR, Dhaka
4. MO. Transfusion Medicine, DMCH, Dhaka
5. Prof. Transfusion Medicine, DMC, Dhaka
6. Asso. Prof. Transfusion Medicine, DMC, Dhaka

Correspondence: Dr. Fahmida Sharmin Chowdhury, Asso. Prof., Transfusion Medicine, NIKDU, E-mail: drmdaliehsan@ g mail.com

maximum". The clinical practice guidelines for the use of blood components aim to: improve the consistency and appropriateness of transfusion practice; promote the integration of quality management systems into transfusion practice; reduce the overall number of transfusion-related complications; increase consumer awareness of the benefits and risks of blood component therapy; and conserve a limited resource. [3]

Merits of components transfusion: Overload avoided, greater shelf life than whole blood, blood shortage can be overcome for better patient management. [4] Optimal utilization of blood helps in reducing or eliminating the use of allogenic blood and often prevents unnecessary exposure of a patient to the risk of blood-borne endogenous infections. Appropriate and rational use of blood/blood components is required to ensure their availability to needy patients as well as to avoid the unnecessary risk of transfusion-transmitted diseases. [5]

Commonly used components are:[6]

Red Cell Concentrate (RCC)
- Leukocyte-Reduced
- Washed
- Frozen, Deglycerolized
- Irradied

Platelets Concentrate (PC)
- Plateletpheresis
- Platelet concentrates

Granulocytes

Fresh plasma (FP)

Fresh frozen plasma (FFP)

Platelet Rich Plasma (PRP)

Liquid Plasma

Cryoprecipitate

Cryoprecipitate reduced plasma

Red Cell Concentrate:[7]

150 to 200 ml red cells after removing plasma from 1 unit of whole blood. Hb approx 20gm per 100ml. Stored at +2 to +6° C in blood bank refrigerator for 21, 28, 35, or 42 days depending on preservative or additive. Used in replacement of red cells in anemic patient, chronic anemia, congenital hemolytic anemia, oncology patients (chemo/radiation), cardiac, orthopedic, and other surgery, end-stage renal disease, premature infants. Transfusion should be started within 30 min of removal from refrigerator. Must be ABO and Rh compatible. Should be completed within 2 hrs 30 mins. In non urgent settings, transfuse one unit at a time. For infant,5 to 10 ml/kg. One unit increases Hb 1 g/dL and hematocrit by 3% in a 70 kg adult.

RCC Types:[8]

RCC (frozen): d" -65°C for 10 years. Used in patient with multiple red cell antibodies, needing rare blood type, autologous red cells for patients with antibodies to high frequency antigens.

RCC (washed): Good at 1-6°C for 24 hours. Used in patients with IgA deficiency and antibodies to IgA, patient with haptoglobin deficiency and antibodies to haptoglobin, patients with severe transfusion reactions to plasma proteins unresponsive to medications.

RCC(Leukocyte depleted): Reduces the rate of febrile non-hemolytic transfusion reaction, prevent CMV transmission, delay or prevent development of platelet transfusion refractoriness due to HLA antibodies with hematological malignancies or aplastic anaemia, may prevent HLA sensitization in bone marrow, peripheral stem cell, cord blood and solid organ transplantation.

RCC (irradiated):1-6°C for 28 days. Irradiation of cellular blood components containing viable lymphocytes is performed to prevent transfusion associated graft-versus-host disease in patient with profound immunodeficiency or suppression.

Platelet Concentrate:[8]

Single donor unit in a vol. of 50-60 ml plasma containing at least 55×10^9 platelet. Pooled unit (4-6 donor) containing 240×10^9 platelet. Stored upto 4-5 days at 22-24p C with agitation in special bag. Used in treatment of bleeding due to thrombocytopenia, platelet function defects and prevention of bleeding due to thrombocytopenia, e.g. bone marrow failure, some inherited or acquired platelet function disorders depending on clinical features and setting, primary immune thrombocytopenia (ITP) with life threatening bleeding or before splenectomy with platelet count<10 x 10^9/L, disseminated intravascular coagulation with platelet count <50 x 10^9/L. Volume of random donor platelets (RDP) is 50-60 ml and apheresis platelet approximately 250 ml. A pool of 5-6 concentrates is therapeutically equivalent to a plateletpheresis. The FDA guideline dictate that pheresis platelets must contain>$300x10^9$ platelets (6 equivalent units), or >$55x10^9$ in platelet concentrate prepared from units of whole blood. Transfusing a pool of 5 conc. or a plateletpheresis should increase an adult's platelet count by 25-50 x 10^9/L in absence of consumption. Increment will be less if there is splenomegaly, DIC, septicemia. After pooling, platelet conc. should be infused as soon as possible, generally within 4 hrs. Must not refrigerated before infusion. Should be infused over 30 min.

Fresh Plasma (FP), Platelet Rich Plasma (PRP), Fresh frozen plasma (FFP):[8]

Plasma separated from whole blood within 6 hrs of collection is called fresh plasma and platelet rich plasma. Plasma separated from whole blood within 6 hrs of collection and then rapidly frozen to -25p C or colder is called fresh frozen plasma. Contain noncellular portion of blood, including fibrinogen (200-400 mg per unit), antithrombin III, factors V and VIII (0.7 IU per ml), albumin and globulin. Usual vol. 200 – 300 ml. Stored at -25p C or colder for 1 year. Used for replacement of multiple clotting factor deficiency, DIC, TTP, deficiencies of other isolated plasma proteins and factors where concentrates are not readily available (antithrombin, protein C and protein S deficiencies), antithrombin III deficiency in a patient requiring heparin, therapy of acute angioedema, preoperative prophylaxis in hereditary C1-inhibitor deficiency ,reversal of warfarin therapy, massive blood transfusion. FFP is thawed before transfusion at 30-37°C water bath for 30-45 minutes. Stored at +2 to +6°C and transfused within 24 hours. Labile factors rapidly degrade; use within 6 hrs of thawing. Dose is 10-20 ml /kg body weight. In a adult, each unit will increase the activity of plasma clotting factors by about 4%-5% and fibrinogen by about 10mg/kg. If the PTT is less than 45 seconds or INR less than 1.5, plasma transfusion is rarely indicated.

Cryoprecipitate:[8]

Prepared from FFP after thawing at +4p C . Contain factor VIII (80-120 units), fibrinogen (150-250 mg), von Willebrand factor (40-70%), Factor XIII (20-30%) and fibronectin . Volume is approximately 5-20ml. Stored at -25p C or colder for 1 year. Used in factor VIII deficiency (Hemophilia A), factor IX deficiency (Hemophilia B), von Willebrand's Disease, congenital or acquired fibrinogen defects (i.e., dysfibrinogenemia). Indicated for bleeding associated with fibrinogen level <100 mg/dL and Factor XIII deficiency.Usual dose is one cryoprecipitate unit per 10 kg of body weight.

In the absence of heavy consumption or bleeding one unit of cryoprecipitate per 10 kg of body weight raises plasma fibrinogen concentration by 40 - 50 mg/dL. One unit will increase Factor VIII activity by about 4% and fibrinogen by about 7-10 mg/dL in a 70 kg adult. Must be transfused within 6 hrs of thawing.

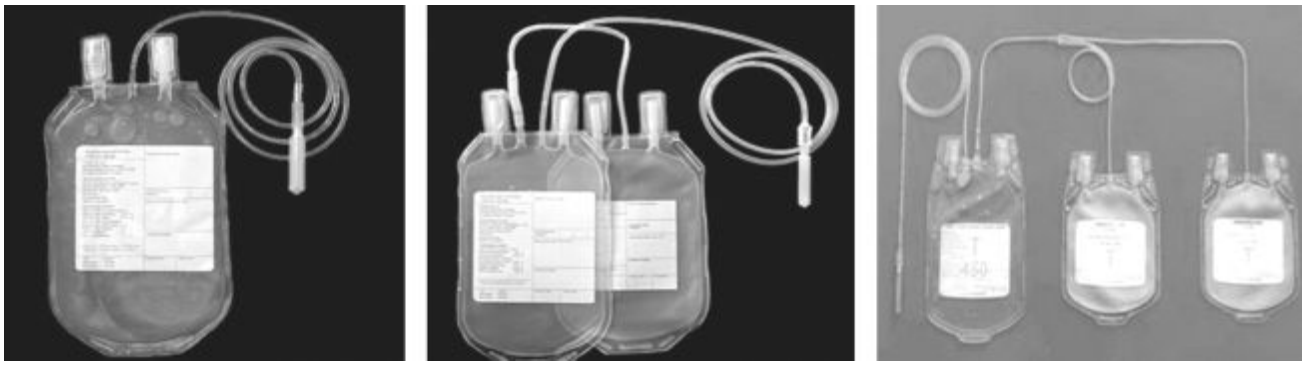


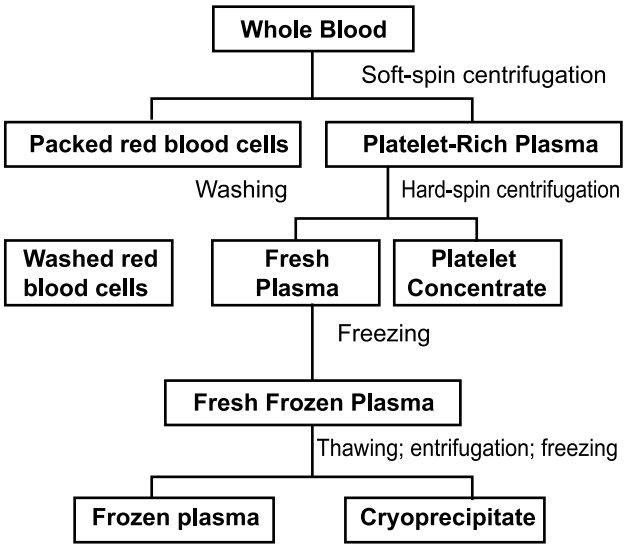
Fig.-1: *Blood bags used for component preparation.* STEPS OF BLOOD COMPONENTS PREPARATION

Cryoprecipitate reduced plasma:[8]

Approximately 300ml per unit. Commonly called cryo-poor plasma that has been depleted of cryoprepitable protein. It is used for patient with TTP requiring plasma exchange.

Granulocyte concentrate:[8]

Usual volume is 150-300 ml. Contain 2-3x10^{10}. Used for patient with infections unlikely to respond to high dose of antibiotic.



Methodology

This observational study was done in Transfusion Medicine Department of Dhaka Medical College Hospital between the period of January 2008 to December 2011**.** Donors of 18 to 60 years of both sexes were selected after reviewing the questionnaire,

physical and medical examination and written consent Certain additional and specific conditions. have to be met when separating whole blood into components. Aspirin or Aspirin containing compounds depress platelet function for 1 to 5 days. Therefore, blood collected from a donor with Aspirin intake within five days prior to donation was not only source of platelet concentrate for a particular patient. Approximately 450 ml blood is collected in a sterile pyrogen free multiple plastic bag system with integral tubing in a closed system. Donation of one unit of whole blood ideally should not be more than 10 minutes. If duration is more than 15 minutes, the plasma was not used for preparation of platelet or plasma. Immediately after collection, the tube was sealed, all the satellite bags were identified and numbered and labeled as on original unit. The blood was processed for component preparation within 6 hours of collection. Meanwhile it was stored at 2^0C to 6^0C except for the preparation of platelets, in which case , it was stored at 22^0C to 24^0C. For pooling, saline washing and other open system processing, aseptic techniques and pyrogen free equipments were used. Blood components were prepared by centrifugation of whole blood in a refrigerated centrifuge machine, which results in sedimentation of various blood components into the different layers depending on their size and density. Thus, the red cells are at the bottom, leucocytes at the top of the red cell mass; next the platelets and lastly, the plasma in the upper part of the bag. After the first centrifugation, the primary bag is placed in a plasma extraction system and the layers are transferred one by one, into satellite bags within the closed system. For platelet preparations, centrifugation is done at 22^0C and for all other products at 4^0C. Red cell units are stored at 4^0C. Platelet rich plasma further centrifuged to prepare platelet concentrates to be stored at room temperature and plasma stored in a frozen condition.[9] Data was collected using a pre-tested questionnaire on age, gender, department, haemoglobin levels, indications of blood transfusions, types of product advised, total number of units ordered, cross-matched and transfused. Rational use of blood was assessed by determining prevalence of appropriateness using World Health Organisation\'s clinical practical guidelines and transfusion indices. Interviews were done with doctors to assess their knowledge and practices.

Results

Results were arranged at tables.

Table I

No. of whole blood collected vs No. of component prepared

Period	No. of unit collected	No. of component prepared	%
2008	14560	1231	8.45
2009	16984	1636	9.63
2010	16980	1380	8.13
2011	20202	1800	8.91
Total	68726	6047	8.79

Table II

Component prepared yearly

Period	RCC	Plasma	PRP	PC
2008	522	504	18	187
2009	762	762	00	112
2010	623	605	18	134
2011	790	760	30	220
Total	2697	2631	66	653

Table III

Use of RCC in different department

Department	No. of unit	%
Haematology	1267	46.98
Onchology	1133	42.01
Nephrology	189	07.01
Obstetric	108	04.00
Total	2697	100.00

Table IV

Use of Plasma in different department

Department	No. of unit	%
Burn	2050	77.91
Hepatology	497	18.89
Obstetric	127	4.83
Paediatric	57	2.17
Total	2631	100.00

Table V

Use of PRP in different department

Department	No. of unit	%
Medicine (dengu)	57	86.36
Obstetric (DIC)	09	13.64
Total	66	100.00

Table VI
Use of PC in different department

Department	No. of unit	%
Medicine (dengu)	355	54.36
Haematology	256	39.20
Obstetric	42	6.44
Total	653	100.00

Discussion

Blood transfusions are a common practice in hospital settings. However, rational use of blood transfusion remains variable among healthcare institutions and patient populations. Despite mounting evidence demonstrating significant harm from unnecessary blood transfusions, results of several studies conducted in developed countries documented a generalised lack of compliance with appropriate transfusion guidelines as well as tremendous variation in transfusion practice among different institutions and among individual physicians within the same institution.

The objective of the study was to assess rational use of blood and blood products in various departments in DMCH, determining the prevalence of appropriate use of blood and blood products; determining blood cross-match ordering practices; and assessing the knowledge and practices of physicians about the rational use of blood and blood products.

In 2008, 1231(8.4%) components were prepared against 14560 whole blood. In 2009, 1636 (9.63%) components against 16984 whole blood were prepared. In 2010, 1380 (8.13%) components were prepared against 16980 whole blood. In 2011 ,1800 (8.91%) components were prepared and supplied to surgery, medicine, gynae, paediatrics, haematology and oncology wards. Study showed that whole blood transfused more (91%-92%) than components (8%-9%). Only department of hematology made irregular follow up of some patient by Hb%, platelet count, clotting factor assay. So data about appropriate use could not be collected. Again in Dengu shock syndrome platelet concentrate used more than platelet rich plasma. Although platelet rich plasma is more beneficial.

As per the WHO criteria, 6-16 units (average of 11 units) of blood are required per hospital bed. In Pakistan at the existing level shortage amounts to as much as 40%.[11] The problem is further compounded by inappropriate use of blood which is up to 25% without separation into its components, with 80-85% of blood being used as whole blood.[12-14] According to the International Red Cross, if blood was used more appropriately, the number of transfusions could be brought down by 30%.[15]

WHO[16] strongly discourages single-unit transfusions in adults and, hence, clinical practice is now dominated by two-unit transfusions. Thus, many units of blood routinely ordered are not utilized, but are held in reserve, loss of shelf life and wastage of blood.[17] In the absence of an explicit maximum blood order policy in hospitals, ordering for blood transfusion is frequently based on subjective anticipation of blood loss instead of evidence-based estimates of average requirement in a particular procedure. Implementation of maximum surgical blood ordering schedule (MSBOS) can result in about 60% reduction of cost to the patient.[18]

Rational use of blood implies that right blood product is to be given to the patient only when needed and in the right amount.[19] Therefore, it is essential to look into the existing blood transfusion practices and collect background information about the type of existing blood transfusion practices e.g. requests for single-unit transfusion, fresh blood transfusion, use of whole blood etc. in a hospital setting..

In the public hospital of pakistan, appropriate use of blood was only 54.1% (n=92) as compared to the private hospital where the appropriateness was 69.4% (n=125). The cross-matched-to-transfusion ratio was 1.1 and 2.7, where transfusion index was 2.6 and 2.5 in public and private hospital respectively. Doctors had good clinical knowledge, but were not using any guidelines.[20]

It was found that criteria for appropriate transfusion were fulfilled by 54% in the public and 69% in the private hospital. This finding was, however, lower compared to previous studies conducted in other hospitals in Pakistan where appropriate transfusions were 80-85% but in those studies no standard guidelines had been used or at least not mentioned in the methodology.Even in developed countries[21] inappropriate transfusion is in the range of 18-35%, while in India the range varied from 30% to 60%[22,23] which is almost the same as in this study.

The limited available information from developing countries also suggests that blood transfusion practices are not in accordance with international guidelines for safe and rational use of blood transfusions. Doctors do not consistently follow any standard guidelines and base their decision to transfuse on anticipated blood loss, past experience, subjective personal judgment, misconceptions, myths and prescribing by habit.[24-26]

Most indications for whole blood transfusion are now well-managed exclusively with blood component therapy, yet the use of fresh whole blood was still seen in the public hospital on a routine basis, when there was no compelling evidence for the use of whole blood in preference to component therapy for its routine.[27] It is similar to this study. At DMCH 91%-92% whole blood were transfused and transfusing. The rate of component preparation and transfusion is very poor, only 8%-9%.

Rational use of blood implies that blood is to be given to the patient only when needed. As per the WHO criteria, 6-16 units (Average. 11 units) of blood are required per hospital bed. This works out to be 60 Lakh units per year for India. At the existing level shortage amounts to as much as 60%, and at the same time unnecessary transfusions range between 30% to 60%.[28]

Of the total 184 episodes of blood component transfusions, 153 (83.1%) episodes were appropriate and 31 (16.9%) episodes were inappropriate. Among these, fresh frozen plasma transfusions had highest inappropriate [18/41 (58%)] episodes followed by packed red cell transfusions [11/110 (35.5%)] and platelet transfusions [2/5 (6.45%)]. There was no inappropriate episode of cryoprecipitate transfusion.[29]

Practices regarding transfusion of single and multiple units of blood and its components revealed that single unit transfusion was seen in all departments of the hospitals. Although WHO[11]suggests that there is no benefit in transfusing 1 unit of RCC, as it is insufficient to correct anaemia. A study conducted in Canada to address the role of single-unit transfusions as a blood-saving technique revealed that a single-unit transfusion strategy could be an effective, simple, practical and cost-saving method of reducing the risks associated with allogenic blood exposure. Transfusion of a single unit should not be considered inappropriate by itself. However, its use without appropriate clinical judgment is not acceptable. In a country like Bangladesh, where there are resource constraints, the use of single-unit transfusion can thus be acceptable.

There is need to change attitudes and orientation. It does not require large capital or technology. Moreover, this basic approach of collecting representative data of current practices may be a useful first step towards improving rational use of blood. It is high time for Bangladesh to implement policies towards educating doctors regarding current practices in blood transfusion. Frequent audit of transfusion practices is highly needed. Compliance with standard guidelines can reduce unnecessary costs to hospitals and patients and the well-known risks of blood transfusion. Strict clinical governance by senior physicians and external quality checks are necessary to modify physicians' behaviour in ordering unnecessary transfusions. By developing and implementing comprehensive blood management programmes focusing on implementation of evidence-based transfusion guidelines to reduce variability in transfusion practice in hospitals can promote safe and clinically effective blood utilisation.

Conclusion

The present study reinforces the importance of blood audit in the clinical setting. Judicious implementation of guidelines for use of various blood products may help to decrease the inappropriate use of blood components. Regular transfusion audit can thus alter clinical practice which may also translate into risk reduction.

One unit of blood can save many. Safe blood product, use correctly, can be life saving.

Reommendation

It is the duty of the official at the blood bank to ensure that transfusions are rational. It is recommended that transfusion practices can be improved and made rational by increasing the capacity of the blood bank, by the availability of facilities for component therapy preparation and storage. Blood bank should create awareness among doctors about component use and should also create awareness in general public that it is very essential to donate blood and it does not do any harm to the donor.

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