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REVIEW ARTICLE

Blood Transfusion Practices in Obstetrics

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ABSTRACT

Transfusion of blood and blood components is a common practice in obstetric wards but it is not without risk. The incidence of transfusion reactions varies from 4 in every 100 transfusions for nonhemolytic reactions to 1 in every 40,000 for hemolytic transfusion reactions. Appropriate and rational use of blood/components is essential for ensuring availability for the needy as well as preventing risks of transfusion-transmitted diseases and saving resources. Rational use means providing the right blood or products, in the right quantity, to the right patient and at the right time, bridging demand, and supply gap. The safety, adequacy, and effectiveness can only be achieved if unnecessary transfusions can be prevented. This article discusses the physiological basis of transfusion as well as the blood components involved.

Keywords: Blood transfusion, Fresh frozen plasma, Obstetrics, Platelet transfusion.

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INTRODUCTION

Obstetric hemorrhage has been the foremost cause for maternal mortality worldwide. According to the World Health Organization (WHO),[1] over a thousand of all maternal deaths are unswervingly because of obstetric hemorrhage. There are many obstetric conditions that most commonly lead to hemorrhage including placental abruptions, postpartum hemorrhage, and placenta previa. Flow of blood to the placenta is around 700 mL/min at term, so the occurrence of bleeding is most probably sudden and somewhat difficult to control.[2] Transfusion of blood and its components is a possibly lifesaving process. Though thorough care is taken in the assortment of blood donors, processing, storage, and transfusion of blood products, however, serious transfusion linked difficulties might result.[3-6] It is the responsibility of the physician to take care of the necessary steps that a blood product is indicated, and the standard practices for the transfusion of the blood is observed.[7] Obstetric conditions linked with the requirement for blood transfusion might cause morbidity and mortality if not fared appropriately. The increasingly important issues in blood transfusion are adverse events associated with transfusion, including potential infection and potential transmission of prions, rising costs, and the possible future problems of availability. The aim of this review is to offer guidance about the appropriate use of blood products that neither compromises the affected woman nor exposes her to unnecessary risk.

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PHYSIOLOGICAL BASIS OF TRANSFUSION

The major aim for transfusion of blood and its components is to:

- Increase the oxygen-carrying capacity of the blood.
- Replacement of clotting factors which are lost, consumed, or not produced.

Underneath the normal situations, the delivery of oxygen to the tissues is 1000 mL/min and the oxygen consumption is 200 mL/min. Henceforth, the ratio of oxygen delivery to oxygen consumption is 5:1. In case of patients suffering from anemia, hypoxia, or myocardial failure in whom the utilization is enhanced, and the delivery of oxygen cannot be enhanced, this ratio of 5:1 will drop in the patient consuming up the inherent oxygen reserves. This situation continues until the ratio falls to 2:1 up to which level the patient rests stable. Thus, the reference to transfuse a patient must lay emphasis on compensatory capability of the patient and physiologic parameters and not only on the packed cell volume (PCV) as is the case normally. Transfusion, thus, is only necessary when patients cannot counterbalance for their anemia.

When the compensatory mechanisms are normal with a tolerable oxygen delivery, it might not be obligatory to transfuse patients until the PCV drops below 16% (hemoglobin, Hb < 5.3 gm/dL) and in patients with poor compensatory mechanisms may only be advised when the PCV drops below 25% (Hb < 8.3 gm/dL).[8-10]

Hemoglobin usually ranges between 12 and 18 gm/dL differing on race, age, sex, and medical condition. The capability of bearing the lower concentrations of Hb depends on:

- The degree and size of blood loss.
- State of tissue perfusion.
- Preexisting cardiopulmonary disease.

BLOOD COMPONENTS

Unlike prior situations, whole blood is presently considered as raw material rather than transfusion medium. Just a single sign for whole blood transfusion is exchange transfusion. Blood component preparation was developed in 1960 to isolate blood items from one unit whole blood by specific apparatus called as refrigerated centrifuge. The accessibility of multiple plastic blood collection bags with integral tubing, blood banks, refrigerated centrifuge, deep freezers, and platelet agitator with incubator and cell separator machines have made the blood part treatment simpler and functional.[11-14] The preparation of transfusing whole blood is now old-fashioned. It is instead switched by different blood components, such as packed red cells, leukoreduced red blood cells, platelet concentrate, fresh frozen plasma (FFP), cryoprecipitate, cryo-poor plasma, apheresis blood components.

Packed Red Cells

Packed red blood cells are the one and only blood product that provides oxygen carrying capacity and one of the most appropriate therapy for patients who require red blood cells due to hemorrhage. These are made after the separation of plasma from the whole blood and are stored at 4°C or frozen at −80°C. These are kept anticoagulated with citrate, phosphate, and dextrose.[15,16]

Leukoreduced Red Blood Cells

The significance of leukoreduced blood components is their transfusion that significantly reduces the probabilities of adverse blood transfusion reactions. A number of research studies have confirmed this fact.[17-22] In earlier times, blood was stored and then filtered before being released for transfusion, but presently, the ingenuous practice of separating blood components before its storage (prestorage filtration) counteracts accretion of cytokines, which are generated by leukocytes in transfusion products. This preparation suggestively decreases the occurrence of febrile nonhemolytic transfusion reactions. There is also the presence of buffy coat layer (that includes white cells, platelets, and debris) which is formed between the red cells and the plasma by centrifugation of blood. These leukoreduced blood components are made by removing the buffy coat layer using the blood collection bags and the vacuumized extractors. However, there are some advantages which include improved therapeutic sustainability of platelets from the buffy coat layer, no chance of contamination with lymphotropic viruses, and the better quality and yield of components.[23]

Platelet Concentrate

In the perioperative and peripartum hemorrhage, platelet transfusion is done when a quantitative or qualitative platelet defect is the alleged source of bleeding. Increase in bleeding at surgical and obstetric patients during the platelet count is, however, unknown. In case of bleeding patients, irrespective of the platelet count, correction of anemia should also be deliberated as well as the avoidance of hemorrhage. While in case of nonbleeding patients, if stable, platelet count should be <10,000/μL; patients taking heparin and are likely to bleed should have platelet count of <20,000/μL; patients with intracerebral, pulmonary, and ophthalmic hemorrhage should have the platelet count <70,000 to 1,00,000/μL, while patients in general surgery should have the platelet count of <50,000/μL. There might be some allergic and febrile transfusion reactions seen in patients with multiple transfusions.[24,25]

Fresh Frozen Plasma

Fresh frozen plasma is the plasma which is removed from the whole blood within 6 hours of collection and make it freeze at −20°C or below. It is then thawed between 30 and 37°C with an agitator. Once the thawing process is done, it should be used within a day to obtain sufficient level of coagulation factors V and VIII. Fresh frozen plasma is primarily used for the replacement of the coagulation factors. There might occur some allergic and febrile transfusion reactions.[26]

Cryoprecipitate

Cryoprecipitate is the precipitate or the insoluble portion of the plasma which is left behind after the FFP has been thawed. These precipitates consist of fibrinogen, fibronectin, factor XIII, factor VIII, and Willebrand's factor. They can be stored below −30°C for a year. These precipitates can be transfused immediately within 6 hours after thawing. The major drawback is the improved risk of hemolytic reactions due to small amounts of anti-A, anti-B, and Rh antibodies left over in preparation, as it is obtained from multiple donors.[26]

Cryo-poor Plasma

These plasmas contain all the constituents except for the fibrinogen and factor VIII. The difference is just the levels which are comparably lower than in others. These plasmas have the same infection risks as that for the whole blood.[27]

Apheresis Blood Components

Apheresis is the medical method that utilizes the cell separator instrumentation that includes detaching the

whole blood from a donor and separating the blood into individual components so that one particular component can be detached. The residual blood components then are restored back into the bloodstream of the patient or donor. Apheresis is used for the collection of donor blood components (such a platelets or plasma) as well as for the management of different medical problems in which a part of the blood that contains disease-infuriating components is detached. The number of platelets collected with this technique signifies the equivalent of 4 to 6 units of random donor platelets. These blood components are becoming very much popular these days since it helps in improving the blood safety by decreasing the exposure of the donor to patient, reduced bacterial contamination, and reduced chances of refractoriness. Moreover, platelets can be donated twice in a period of 1 week by a single donor.[28]

Irradiated Blood Components

These components have gained significant importance recently in immunosuppressed patients due to transfused donor lymphocytes. Transfusion linked with graft versus host disease is a rare condition but usually fatal problem of transfusion. The disease occurs when the lymphocytes of the donor enter and proliferate the recipient, causing damage to the target organ, especially skin, liver, gastrointestinal tract, and the bone marrow.[29]

BLOOD TRANSFUSION IN MAJOR OBSTETRICS HEMORRHAGE[30-34]

Severe blood loss conditions in obstetrics are mostly associated with issues, such as placenta previa, postpartum blood loss, and surgeries. This leads to an early requirement of consultant obstetrician, anesthetist, hematologist, and the blood bank contributions. There are no definite guidelines for initiating red cell transfusions. Different clinical and hematological parameters are needed to be considered for making an appropriate decision, such as:

- Transfusion of blood is promoted when the PCV is less than 21% (in patients without any cardiac pathology) which is infused in a ratio of 3 volumes of crystalloid to 1 volume of blood. Under the conditions of severe shock, the ratio is raised up to 8:1.
- Fresh frozen plasma infusion should be considered before one blood volume is lost.
- Earliest hemostatic abnormality is encountered with fibrinogen deficiency condition when packed red cell concentrates are utilized for replacing major blood loss.
- The platelet count should be monitored, as it must not fall below 50×10^9/mL in the acutely bleeding patient. A platelet transfusion of 75×10^9/mL provides a safety margin. A platelet count of 50×10^9/mL is expected if two blood volumes have been replaced by fluid or red cell components.
- Anti-Rh D (250 IU) is required if the platelets are Rh D positive and the recipient is Rh D negative, but is avoided if a cesarean hysterectomy has been performed.
- The FFP and cryoprecipitate should preferably be of the same group as the recipient. If it is not available, then FFP of a different ABO group is acceptable if it does not comprise a high titer anti-A or anti-B activity. Anti-D prophylaxis is not essential if an Rh D-negative woman receives Rh D-positive FFP or cryoprecipitate.
- A combination of FFP, platelets, and cryoprecipitate is observed in women undergoing bleeding with disseminated intravascular coagulation (DIC).
- Maintenance of fibrinogen levels above 1.0 gm/L through the transfusion of FFP.
- The most prominent cause of coagulopathy is dilution of coagulation factors in major blood loss conditions following red cell components transfusion and volume replacement with crystalloid or colloid.
- History of women with prolonged hypoxia, hypovolemia, or hypothermia (for instance, owing to inadequate resuscitation), amniotic fluid embolism, placental abruption, and preeclampsia are at higher risk of DIC. Transfusion of FFP should be considered among women who are at risk of DIC if hemorrhage is otherwise difficult to control.
- If there is profuse bleeding from the site associated with trauma and oozing from the venipuncture and intravenous line insertions sites, then DIC is suspected. Common practice for administrating FFP 12 to 15 mL/kg for management of activated partial thromboplastin time and prothrombin time ratios less than 1:5 as major reason for transfusion in clotting factors.
- The recombinant factor VIIa usage is involved in treatment for life-threatening postpartum hemorrhage. However, it should not be used in life-saving procedures like embolization or surgery, in which the patient is to be transferred to a referral center for the same.
- Blood transfusion from blood banks might cause neutrophil cytotoxicity that is a major reason for multiple organ failure (MOF) while early transfusion is risk factor for MOF. In moderate hemorrhagic shock with blood loss conditions, normal saline or Ringer's lactate can be used for volume replacement and in massive hemorrhagic shock, Ringer's lactate is the most effective fluid. Replacement of colloids by crystalloids is observed due to the colloid's tendency of leakage from permeable capillary membranes that worsen edema

and impairing tissue oxygenation. Large volumes of crystalloids have been involved in adult respiratory distress syndrome and the abdominal compartment syndrome that might be caused by colloids, but overall crystalloids are effective treatment option.

COMPLICATIONS IN BLOOD TRANSFUSION[35,36]

Blood transfusion might be a savior, but it is not without menaces. Recipients might develop transfusion-transmitted infection or some immunological sequelae, such as red cell alloimmunization in rare conditions. Thus, proper administration procedures, sampling, and crossmatch should be taken care of in emergency situations.

- Acute hemolytic reactions occur because of immune destruction of transfused red cells. The destruction of donor red cells occurs within 24 hours while the incidence is 1 in 50,000 transfusions.
- Allergic reactions might range from mild urticaria to severe anaphylaxis. These reactions occur in 1 to 3% of transfusions and are a response to proteins in the donor plasma.
- Transfusion-related acute lung injury (TRALI) is a noncardiac pulmonary edema that occurs within 6 hours of transfusion. Donor products from multiparous women are associated with TRALI and is the leading cause of posttransfusion mortality.
- Febrile nonhemolytic transfusion reaction is the rise of body temperature within 24 hours of transfusion. Proposed mechanism is the release of endogenous pyrogens or cytokines. These reactions are minimized by using leukodepleted blood products.
- Circulatory overload is common in women with anemia, especially with rapid transfusion. Symptoms include tachycardia, cough, dyspnea, and hypertension. Treatment is with diuretics. Prevention is by transfusing small volumes of packed cells at a slow rate.
- Transfusion-related graft versus host disease is a delayed reaction mediated by the donor lymphocytes proliferating and mounting an acute attack against the recipient's tissues. It is seen in immunocompromised patients and has a high mortality rate. Prevention is by using leukodepleted blood or irradiated blood components.

ANTENATAL ASSESSMENT OF RHESUS HEMOLYTIC DISEASE OF NEWBORN

The major objective of antenatal assessment is to recognize women with an elevated possibility of having their babies affected with hemolytic disease of the newborn (HDN), so that they can be inspected during pregnancy to evaluate the amount of involvement for proper management. Analyses should be started at about the 12th week of pregnancy or at the first visit to the obstetrician.[37] Some of the key points should be kept in mind while having antenatal assessment:

- Women with the history of HDN, still-birth, hydrops fetalis, or evidence of Rh immunization should be closely monitored.
- Rh-positive blood transfusion might help to immunize an Rh-negative woman.
- Sera for both Rh (D)-positive and Rh (D)-negative women should be screened for the red cells antibodies on the 1st visit to the obstetrician and at 34 to 36 weeks of gestation.

SELECTION OF BLOOD FOR AN INTRAUTERINE BLOOD TRANSFUSION

When fetal RBCs are being destroyed by Rh antibodies, an intrauterine transfusion provides blood to the Rh-positive fetus. Blood transfusion is very much required to replace the fetal red blood cells that are being destroyed by the immune system of the Rh-sensitized mother. That blood is known to lack HbS in order to prevent sickling under the low oxygen tension and is being exposed to prevent the transfusion associated graft versus host disease in the immunologically immature fetus. Few studies have reported that using RBCs that are antigen matched to the mother reduces the risk of further maternal sensitization from intrauterine transfusion.[38]

CONCLUSION

Hemorrhagic emergencies are very much common in obstetrics. Blood component therapy should be properly administered for the management of specific conditions like microvascular bleeding, coagulation factor deficiency, and inadequate oxygen delivery. Some of the major adverse reactions are likely to occur post transfusion, such as graft versus host reaction, febrile reactions, allergic reactions, and acute lung injury. Suitable and well-adjusted use of blood components is very much required for certifying the availability for the needy as well as avoiding the risks of transfusion-transmitted diseases and saving resources. This can be completed by perceptive accomplishment of guidelines for use of various blood products.

REFERENCES

1. WHO. Micronutrient deficiency: battling iron deficiency anaemia: the challenge. Geneva: WHO; 2004. [cited 2018 Jul]. Available from: http://www.who.int/nutrition/topics/ida/en/.
2. Francis JJ, Tinmouth A, Stanworth SJ, Grimshaw JM, Johnston M, Hyde C, Stockton C, Brehaut JC, Fergusson D, Eccles MP. Using theories of behaviour to understand transfusion prescribing in three clinical contexts in two countries: development work for an implementation trial. Implement Sci 2009 Oct;4:70.

3. Gragnolati, M.; Shekar, M.; Gupta, MD.; Bredenkamp, C.; Lee, YK. India's undernourished children: a call for reform and action. Washington (DC): World Bank Report; 2005. [cited 2018 Jul]. Available from: http://www.siteresources.worldbank.org/HealthNutritionPopulation/Resources/2816271095698140167/IndiaUndernourished-ChildrenFinal.pdf.
4. New York State Council on Human Blood and Transfusion Services. Guidelines for physician options for blood conservation. Albany (NY): New York State Department of Health; 2002.
5. Bonnar J. Massive obstetric haemorrhage. Baillieres Best Pract Res Clin Obstet Gynaecol 2000 Feb;14(1):1-18.
6. WHO. The world health report 2005: make every mother and child count. Geneva: WHO; 2005. [cited 2018 Jul]. Available from: http://www.who.int/whr/2005/en.
7. Sacks, DA. Blood component replacement. In: Belfort MA, Saade GR, Foley MR, Phelan JP, Dildy GA III, editors. Critical care obstetrics. 5th ed. Hobken (NJ): Wiley Blackwell; 2010. pp. 165-180.
8. American College of Physicians. Practice strategies for elective red blood cell transfusion. American College of Physicians. Ann Intern Med 1992 Mar;116(5):403-406.
9. Innes G. Guidelines for red blood cells and plasma transfusion for adults and children: an emergency physician's overview of the 1997 Canadian blood transfusion guidelines. Part 1: red blood cell transfusion. Canadian Medical Association Expert Working Group. J Emerg Med 1998 Jan;16(1):129-131.
10. Nigam A, Prakash A, Saxena P. Blood transfusion on obstetrics. Kathmandu Univ Med J (KUMJ) 2013 Oct-Dec;4(44):355-359.
11. Brecher, ME; American Association of Blood Bank. Technical manual. 15th ed. Bethesda (MD): American Association of Blood Bank; 2005.
12. Makroo, RN. Principles and practices of transfusion medicine. New Delhi: Kongposh Publication; 2014.
13. Saran, RK; India Directorate General of Health Services; WHO. Transfusion medicine: technical manual. 2nd ed. New Delhi: Directorate General of Health Services, Ministry of Health and Family Welfare, Govt. of India; 2003.
14. Fuller AJ, Bucklin B. Blood component therapy in obstetrics. Obstet Gynecol Clin North Am 2007 Sep;34(3):443-458.
15. Connell NT. Transfusion medicine. Primary Care 2016 Dec;43(4):651-659.
16. Carson JL, Guyatt G, Heddle NM, Grossman BJ, Cohn CS, Fung MK, Gernsheimer T, Holcomb JB, Kaplan LJ, Katz LM, et al. Clinical practice guidelines from the AABB: red blood cell transfusion thresholds and storage. JAMA 2016 Nov;316(19): 2025-2035.
17. Bowden RA, Slichter SJ, Sayers M, Weisdorf D, Cays M, Schoch G, Banaji M, Haake R, Welk K, Fisher L, et al. A comparison of filtered leukocyte-reduced and cytomegalovirus (CMV) seronegative blood products for the prevention of transfusion-associated CMV infection after marrow transplant. Blood 1995 Nov;86(9):3599-3603.
18. Andreu G, Dewailly J. Prevention of HLA alloimmunization by using leukocyte depleted components. Curr Stud Hematol Blood Transfus 1994;60:29-40.
19. Vamvakas EC. Meta-analysis of randomized controlled trails of the efficacy of white cell reduction in preventing HLA-alloimmunization and refractoriness to random donor platelet transfusion. Transfus Med Rev 1998 Oct;12(4): 258-270.
20. TRAP study group. Leukocyte reduction and ultraviolet Birradiation of platelets to prevent alloimmunization and refractoriness to platelet transfusions. N Engl J Med 1997 Dec;337(26):1861-1869.
21. van de Watering LM, Hermans J, Houbiers JG, van den Broek PJ, Bouter H, Boer F, Harvey MS, Huysmans HA, Brand A. Beneficial effects of leukocyte depletion of transfused blood on postoperative complications in patients undergoing cardiac surgery. Circulation 1998 Feb;97(6):562-568.
22. Jensen LS, Kissmeyer-Nielsen P, Wolff B, Qvist N. Randomized comparison of leukocyte depleted versus buffy coat poor blood transfusions and complications after colorectal surgery. Lancet 1996 Sep;348(9031):841-845.
23. GE Healthcare. Isolation of mononuclear cells: methodology and applications. Sweden: GE Healthcare; 2010. [cited 2018 Jul]. Available from: https://www.sigmaaldrich.com/content/dam/sigma-aldrich/docs/Sigma-Aldrich/General_Information/1/ge-isolation-of-mononuclear-cells.pdf.
24. Makroo R, Agarwal G. Blood component therapy and transfusion practice in obstetrics. World Clin Obstet Gynecol 2018;7(1):112-125.
25. Beutler E. Platelet transfusions: the 20,000/microL trigger. Blood 1993 Mar;81(6):1411-1413.
26. Rege K, Bamber J, Slack MC. Blood transfusion in obstetrics (Green-top Guideline No. 47). Minor Rev 2008 Jul;2(5):1-10.
27. Roewer J, Dettmann C. Component therapy with cryo-poor plasma (CPP). Beitr Infusionsther 1990 Feb;26:168-173.
28. Kor DJ, Stubbs JR, Gajic O. Perioperative coagulation management—fresh frozen plasma. Best Pract Res Clin Anaesthesiol 2010 Mar;24(1):51-64.
29. Eiermann TH. Indications for irradiated blood components: dose and side effects. Beitr Infusionsther 1993;31:70-73.
30. O'Shaughnessy DF, Atterbury C, Bolton Maggs P, Murphy M, Thomas D, Yates S, Williamson LM; British Committee for Standards in Haematology, Blood Transfusion Task Force. Guidelines for the use of FFP, cryoprecipitate and cryosupernatant. Br J Haematol 2004 Jul;126(1):11-28.
31. British Committee for Standards in Haematology; Stainsby D, MacLennan S, Thomas D, Isaac J, Hamilton PJ. Guidelines on the management of massive blood loss. Br J Haematol 2006 Dec;135(5):634-641.
32. Botha AJ, Moore FA, Moore EE, Kim FJ, Banerjee A, Peterson VM. Postinjury neutrophil priming and activation: an early vulnerable window. Surgery 1995 Aug;118(2):358-365.
33. Healey MA, Davis RE, Liu FC, Loomis WH, Hoyt DB. Lactated ringer's is superior to normal saline in a model of massive hemorrhage and resuscitation. J Trauma 1998 Nov;45(5): 894-899.
34. Moore FA, McKinley BA, Moore EE. The next generation in shock resuscitation. Lancet 2004 Jun;363(9425):1988-1996.
35. World Health Organization. The clinical use of blood. Geneva: WHO; 2002. [cited 2018 Jul]. Available from http://www.who.int/bloodsafety/clinical_use/en/Handbook_EN.pdf?ua=1.
36. Sharma S, Sharma P, Tyler LN. Transfusion of blood and blood products: indications and complications. Am Fam Physician 2011 Mar;83(6):719-724.
37. Basu S, Kaur R, Kaur G. Hemolytic disease of the fetus and newborn: current trends and perspectives. Asian J Transfus Sci 2011 Jan;5(1):3-7.
38. Lindenburg IT, van Kamp IL, Oepkes D. Intrauterine blood transfusion: current indications and associated risks. Fetal Diagn Ther 2014 Jun;36(4):263-271.