SALT JOURNAL OF SCIENTIFIC RESEARCH IN HEALTHCARE
February 2021, Vol 1, Issue 1, Page No. 01-10

www.saltjsrh.in
ISSN 2583-3936 (Online)
https://doi.org/10.56735/saltjsrh.ms2101010110

REVIEW ON BLOOD TRANSFUSION DURING PREGNANCY & POSTNATAL PERIOD

PALUKURI YASHWANTH KUMAR, *DARLA SRINIVASARAO , BHARTI SHARMA, BIPUL KUMAR MAHTO
School of Medical and Allied Sciences, Department of Medical Lab Technology, Galgotias University, Greater Noida, India

Article Type: Review Article

Article Citation: Kumar PY, Srinivasarao D, Sharma B, Mahto BK. Review on blood transfusion during pregnancy and postnatal period. SALT J Sci Res Healthc. 2021 February 11; 1(1): 01-04.

Received Date: January 11, 2021
Accepted Date: February 10, 2021
Published Date: February 11, 2021

***Corresponding Author**
Darla Srinivasarao, Assistant Professor, School of Medical and Allied Sciences, Department of Medical Lab Technology, Galgotias University, Greater Noida, India.
ORCID ID: 0000-0002-7366-2529
Email:
darla.srinivasa@galgotiasuniversity.edu.in

ABSTRACT

Patient blood management is a crucial area introduced in almost all medical specialities, such as cardiac surgery, anaesthesiology, and orthopaedic surgery, but the PBM is even more critical in emergency obstetric care. Obstetric haemorrhage is one of the most frequent causes of maternal demise. Due to many factors such as comorbidities and physiological changes, estimating blood loss and the precise demand for blood transfusion during pregnancy is difficult. Numerous guidelines are available to assess the need for blood transfusion; however, the developed countries form all those guidelines used in developing countries. As a result, we investigated the various forms of blood transfusion reactions during pregnancy. We also looked at the frequency and risk variables for postpartum blood transfusion responses. Since patient blood management plays a vital role in minimizing Obstetric haemorrhage, we have also reviewed the guidelines for blood transfusion in obstetrics.

Keywords: Blood transfusion, Patient blood management, Obstetric haemorrhage, Blood transfusion reactions, morbidity.

INTRODUCTION

Transfusion Blood is a small, expensive resource and has unique risks to its use (1,2). This has contributed to expanded international attempts to minimize the excessive use of blood in a range of disciplines (3). Red blood cell transfusion in Australia has generally decreased in recent years (4). However, there is evidence of an increase in maternal red blood cell transfusion levels during childbirth (5). This pattern was also observed in the United States, Canada, Finland and Ireland, particularly in the postpartum haemorrhage context (6-12). There was a steep rise in transfusions during a delivery admission in the United States between 1998 and 2009 (from 0.3 per cent to 1.0 per cent) (12). In 2002, obstetric blood transfusion in Australia was 0.88%, which was higher than current levels recorded in other nations, including the United States (0.46%) in 2003 (7), Canada (0.63% in 2004) (12-13), and Ireland (0.84% in 2003) (11). Reasons for the higher rate are unknown, though they may be related to the collection of data differences. Obstetric transfusions tend to be rapid, spontaneous and in people who are otherwise well (14). A limited number of population-based studies reported risk factors in the maternity setting for blood transfusion, including mode of delivery, placenta previa, antepartum haemorrhage, anaemia, multiple pregnancies, and maternal age extremes (10,15,16). Population data provides a reliable database for pattern analyses and risk factors for unusual events like transfusion (17). Post-childbirth heavy bleeding (postpartum haemorrhage, PPH) and obstetric transfusion levels tend to rise (18-21). More women will start pregnancy with a history of haemorrhage and transfusion from previous pregnancies as the rate of haemorrhage and transfusion rises. Studies have recorded that women with a PPH in their first birth have about three times the chance of PPH in their second birth compared with a woman

with no history of PPPH (22, 23). Instead of using it as a predictor of more serious haemorrhage, few studies have identified the recurrence risk of obstetric transfusion due to low cases (1–2 per cent of births) (22, 23). However, one study from Denmark found earlier transfusion to be a strong predictor of the need for transfusion after subsequent births but did not specifically consider transfusion with or without haemorrhage (24). It's also impossible to anticipate which women will have a postpartum haemorrhage; in future pregnancies, risk factors for postpartum haemorrhage should be addressed while choosing a favourable birth location.

Because much of the original decision on the place of birth is made early in pregnancy, evaluating a prospective haemorrhage risk based on characteristics learned during the woman's pregnancy benefits both the clinician and the patient.

Parturition is the most significant and perilous period of a woman's life; she is endangering her own kid when she gives birth to a new infant. Furthermore, many women die nowadays in both developed and developing nations during pregnancy and childbirth.

Every year, more than 528,000 people are killed. (25). Obstructed labour, haemorrhage, sepsis, eclampsia, ruptured uterus from obstructed labour, and abortion complications account for up to 80% of maternal deaths globally. Of the direct and indirect causes of maternal morbidity and mortality, obstetric haemorrhage is one of the main causes of direct maternal mortality in obstetrics (26-29). In one of the studies, 34 per cent of maternal deaths in Africa accounted for haemorrhage during pregnancy (30). Many maternal deaths can be saved by building up haemoglobin since the incidence of anaemia during pregnancy in India remains as high as 65–75%, as reported by the WHO. Moreover, timely blood transfusion can lower maternal mortality (32). Blood transfusion criteria may be unpredictable conditions, such as. Low Hb, preliminary placenta, or obstructed labour, but need may occur without warning, including uterine inversion, instrumental delivery, or uterine rupture. In high-risk instances, blood can be scheduled and kept on hand ahead of time, but in other cases, it may need to be scheduled on short notice and without warning. Blood transfusions play an important, critical, and life-saving function in obstetric practice. There are an estimated 270 million people worldwide who are either silent carriers or have a haemoglobin problem. The incidence is growing, especially in North America, representing a change in epidemiology (33). Changes in population dynamics due to increased ethnic integration have resulted in a higher number of children born with haemoglobinopathy, increasing the number of cases in obstetrics (34). This trend in population change has led to the increased prevalence of these conditions, making them harder to treat. Although historical carriers may have changes in one gene, patients with a range of permutations are now becoming more common, leading to several new phenotypes and challenging conventional guidelines (35, 36).

How to react blood after received and types of reactions during pregnancy

Blood transfusion is an essential intervention in managing pregnancy complications in sub-Saharan Africa, where anaemia, sepsis, obstetrics haemorrhage, obstructed labour and abortion complications are common. Because blood can save lives, it is recommended as a life-saving measure for lowering maternal mortality(37). Blood transfusion dangers are well-known; they can be classified as acute or delayed, as well as by aetiology (Immunological or non-Immunological) and starting time. Studies have shown that up to 20% of transfusions can cause certain complications (38), Most of these studies are performed in non-pregnant patients, but pregnancy presents a particular challenge as the immune response during pregnancy varies from that of non-pregnant patients, and this may influence the occurrence or onset of complications because it is understood that pregnancy triggers red cells and antibodies (39). Pregnancy is a physiological process involving diligent antenatal treatment to ensure a safe outcome in the preparation. During pregnancy, treatment of anaemia depends on the condition, extent of anaemia and gestation to which anaemia is diagnosed. In the second half of pregnancy, serious anaemia (Hb< 7g / dl) is treated with blood transfusion at every gestation (40). Obstetric haemorrhage is another form of transfusion of blood during pregnancy or childbirth. Obstetric haemorrhage is a common cause of maternal death that causes 24% of ma-

ternal deaths or an estimated 127,000 annually (41). It was also recorded that major (2,000 mL or more) and life-threatening obstetric haemorrhage occurs in 3–5 per cent and 0.1 per cent of deliveries, respectively, and 0.3–1 per cent of blood product transfusion is needed (42-46). Normal pregnancy is characterized by increased maternal circulation components of the complement (48). Additionally, it has been demonstrated that plasma levels of anaphylatoxins are higher in pregnant women than in non-pregnant ones. The complement system is involved in identifying and eliminating bacteria and foreign cells, as well as the inflammatory response, as part of innate immunity. It also forms a link between innate immunity and adaptive immunity (47-50). Blood transfusions also induce acute transfusion (ATR) reactions.

ATRs are estimated to affect 0.2% to 10% of the population and are responsible for 1 in every 250,000 deaths. Transfusion reactions can be hemolytic, nonhemolytic febrile reactions. Fever and chills are caused by nonhemolytic fever reactions, which do not involve the loss of red blood cells (haemolysis). This is the most common response to transfusions. It can happen even if the blood is properly provided and matched(51-53). Anticorps kill donor RBCs in the recipient's circulation during hemolytic transfusion responses (HTRs). Antigen-positive donor RBCs can cause difficulties when transfused into a patient who has tested positive for that antigen. Donor RBCs can be instantly killed (a potentially extreme reaction) or have reduced or even limited survival time (milder reactions).

The reactions to weaker forms of blood are usually milder than those caused by an ABO or Rh blood type mismatch. Rh blood group is a complex network of blood groupings. The highly polymorphic genes that encode the Rh blood type antigens add to the antigens' complexity. There are 49 Rh antigens discovered so far. Antigen-antibody responses during blood transfusion involve these antigens. The destruction of transfused platelets is caused by an immunological reaction to platelets in transfused blood. In rare cases, there may be an immune reaction that affects the lungs of the person causing TRALI (acute lung injury due to transfusion). This is thought to be caused by the recipient's white blood cells being affected by the donor's white blood or plasma cells. It gives rise to dyspnea and other symptoms. The majority of people recover completely from such a reaction. A fluid surcharge is a common form of non-immune response (53,54). Blood transfusion can save lives and provide many patients with tremendous health benefits, but it is not without risks (51). Errors and 'wrong blood' incidents indicate an occurrence of 11.4/100,000 transfused components) (52).

Various types of blood transfusion responses that might occur during pregnancy

1. Hemolytic Reaction: Antibodies against the antigen on the donor's red blood cells are produced by the recipient's serum, resulting in hemolytic responses. This could be an ABO incompatibility or an antigen-related incompatibility for a certain blood group.

After this type of response, disseminated intravascular coagulation (DIC), renal failure, and mortality are common.

A clerical error, such as a mislabeled specimen submitted to the blood bank or it failing to recognise the patient to whom you are giving blood, is the most prevalent cause of a severe hemolytic transfusion reaction (55). A transfusion is defined as a whole blood infusion or any component. Transfusions have advantages and drawbacks, just like any other medical operation. One of the potential complications from transfusions is the hemolytic transfusion reaction. Hemolysis is defined as the breakdown and leakage of red blood cells from their contents. The hemolysis site can be either intravascular (in circulation), or extravascular (in reticuloendothelial). Reactions to hemolytic transfusion may be mediated by immune or non-immune means. Reactions to allergic hemolytic transfusions arise because of the patient's mismatch or incompatibility with the donor materials. Acute and delayed immune hemolytic transfusion reactions are the two types of immune hemolytic transfusion reactions.

Acute hemolytic reactions occur during the first 24 hours of receiving blood, whereas delayed hemolytic reactions take longer.

Delayed reactions usually develop two weeks after the transfusion, however they might last up to 30

days in certain cases.

The type and number of antigens, alloantibodies, and complementary binding capabilities all influence the severity of the hemolytic reaction. Damage to red blood cells or other blood components from heat, osmosis, or mechanical forces can result in non-immune hemolysis. These types of hemolysis are caused by human or machine error. Hemolytic transfusion reactions usually occur more frequently during the transfusion of packed red blood cells, but they can also occur after other blood products have been transfused (56).

2. Febrile Nonhemolytic Transfusion Reaction: The definition of a febrile nonhemolytic transfusion reaction (FNHTR) is an increase in body temperature of 1°C or more that takes place during or following the transfusion of blood components. FNHTRs are more common in platelet transfusions. The main populations experiencing this form of reaction are multiply-transfused patients and multiparous women. The manifestation of an FNHTR involves two mechanisms. The first is the discovery of a white cell antibody that interacts with white blood cells in a patient's plasma. Antibodies can be directed against granulocyte antigens or human leukocyte antigens (HLA). This interaction causes the release of endotoxins that act on the hypothalamus, stimulating a fever. The second process involves generating leukocyte cytokines during the storage of goods. Cytokine development normally happens at warmer temperatures during storage, which is why non-leukoreduced platelets are commonly involved (61).

3. Febrile Reaction: Patient antibodies directed against antigens on transfused lymphocytes or granulocytes elicit white blood cell reactions (febrile reactions). Symptoms usually consist of chills and an increase in temperature > 1^0 C (55). Cytokines and another natural leukocyte, platelet, or plasma constituents accumulate during storage in the blood components. Some recipients respond when blood components are transfused with varying generalized symptoms in which fever is the most common symptom (57-58). RBC transfusions occur in 0.5 per cent and platelet transfusions in 30 per cent. The febrile reaction can take place without hemolysis. In addition to cytokines released by WBCs of storage products, particularly platelets, additional potential causes include antibodies against HLA antigens on donor WBCs or platelets. These are the most frequent causes. Relatively common in patients with multi-transfusions or multipares. In clinical terms, febrile reactions include a one-degree rise in temperature, chills, and, on rare occasions, headache and back discomfort. This can take up to two hours to become apparent. At the same time, allergic reaction symptoms are normal. All febrile reactions, like any other transfusion reaction, must be assessed since fever and chills can suggest a serious hemolytic transfusion reaction.

Acetaminophen and, if necessary, diphenhydramine are effective treatments for the majority of febrile reactions. Patients should also be treated (e.g., before subsequent transfusions with acetaminophen. For subsequent transfusions if a patient has experienced several febrile reactions, special leukoreduction filters are employed; many hospitals now use pre-stored leukoreduced blood components.

4. Allergic reaction: Hives and itchy signs to anaphylaxis are all possible allergic reactions to plasma protein. These reactions can happen in up to 1 in 200 RBC transfusions and 1 in 30 platelet transfusions (55). Patients may experience skin rash ('nettle rash' or hives) and/or itching (pruritus) without any improvement in their vital signs. most typical among patients who receive platelets or other plasma-rich components like FFP. Most common in patients who receive plasma-rich components such as FFP or platelets. Transfusion slowing and antihistamines (oral or IV) often improve symptoms (59). Like any other allergy, allergic reactions to blood products will vary from person to person and include experiencing anaphylaxis or rash. Around 1-3 per cent of patients undergoing a transfusion were found to have moderate reactions. Far less common are anaphylactic reactions that occur in up to 1 in 20,000 blood transfusions (60).

Incidence and risk factors of postpartum blood transfusion reactions

The most common cause of maternal mortality and morbidity worldwide is postpartum haemorrhage (62). In high-resource countries, the number of women requiring blood transfusions as a result of postpartum haemorrhage ranges from 2 to 30 per 1000 deliveries, and the number continues to in-

crease (63-66). While the majority of blood transfusions are healthy, adverse transfusion reactions (TRs) and transfusion-transmitted infections are a fact (67,68). TRs have different effects, depending on the pathophysiology. Symptoms range from moderate to severe, such as fever or hives, and reactions can be life-threatening in some situations. Deaths linked to TRs at a rate of 1 per 100 000 transfused units were recorded (69). TRs may be dichotomized or acute / delayed as immunological/non-immunological. The size, definition, management and risk profile distinguish (70,71). Before receiving a blood transfusion, it is vital to be aware of these side effects, which may lead to the decision to use an alternative to blood transfusion in some situations. The most common TRs are the febrile nonhemolytic reaction and circulatory overload associated with transfusion since 2006, with a reported frequency of 0.1 to 1.0 in 100 transfusions (71-75). The more serious reactions are uncommon, including anaphylactic TRs, septic TRs, acute hemolytic TRs, delayed hemolytic TRs, transfusion-related acute lung injury (TRALI), and transfusion-related graft-to-host disease (70,76). HLA and neutrophil antibodies are associated with TRs, which usually cause mild nonhemolytic reactions with fever and chills; however, the donor or recipient often has leukocyte antibodies associated with TRALI developments (77,78). The maternal immune system is changed during pregnancy because to mediated resistance and vaccination against foetal antigens.

On the other hand, higher levels of HLA antibodies in most pregnancies are observed, particularly in multiparous women (79). During pregnancy, these circumstances can increase the risk of TRs (78,80). The prevalence of antibodies to red cells, leukocytes, and platelets is known to increase in pregnant women (78,79). The incidence of TRs in postpartum females is not known. Our goal was to find out how often postpartum TRs occurred and what characteristics were associated with them in women who received RBCs, plasma, or postpartum platelets transfused.

Patient blood management (PBM) during pregnancy and childbirth

PBM (patient blood management) is a new concept in medicine that has just been introduced in numerous domains. It provides a set of steps and methods for maintaining an optimal level of haemoglobin (Hb), improving haemostasis, reducing blood loss and limiting blood transfusions to enhance patient outcomes. Recent studies have shown that the use of PBM minimizes perioperative bleeding decreases blood transfusion requirements (82–89), perioperative morbidity (82–85), mortality, length of hospitalization (82,85), and costs (90, 91). In this regard, since 2010, the World Health Organization (WHO) has recommended the urgent adoption of PBM [92]. Some hospitals have already adopted PBM successfully, especially in Australia (88), Europe (83,85-87), the United States [84], and even Asia. Many obstetricians and obstetrical departments, on the other hand, require PBM advice in ordinary medical practice. Despite the advantages shown, difficulties and mindsets restrict the application of PBM guidelines to everyday medical practice (93).

DISCUSSION

Modern medicine has been transformed by advances in the field of transfusion medicine. Every healthcare facility's gynaecology and obstetrics departments are major users of blood components. Blood is necessary to battle unfavourable occurrences, which is a possibility if haemoglobin levels are below the recommended levels and if haemorrhagic incidents occur. Transfusion safety has a significant impact on surgical, gynaecological, and chronic patient care. On the one hand, maternal morbidity and even mortality are dependent on the availability of blood and blood products; on the other hand, excessive use of blood and blood products can cause inflammation, allergic reactions, or antibody development in the mother, all of which can have a significant impact on current or future pregnancies. Associated transfusion responses have been found in studies ranging from 6.6 percent to 14.4 percent. The present study's frequency is higher than in the other studies.

CONCLUSION

The current study gives the complete adverse transfusion reactions with possible management intervention for practitioners to understand in the case of pregnant women saving lives during pregnancy and the postpartum period.

REFERENCES

1. Thomson A, Farmer S, Hofmann A, Isbister J, Shander A. Patient blood management—a new paradigm for transfusion medicine? ISBT SciSer 2009; 4: 423–35.
2. Goodnough LT, Shander A. Patient blood management. Anesthesiology 2012;116:1367–76.
3. Shander A, Van Aken H, Colomina MJ, Gombotz H, Hofmann A, Krauspe R, et al. Patient blood management in Europe. Br J Anaesth 2012;109:55–68.
4. Sapere Research Group. Analysis of cost drivers and trends in the blood sector. Options manage appropriate use of blood and blood products. Sydney (Australia): Sapere Research Group;2011.
5. Roberts CL, Ford JB, Algert CS, Bell JC, Simpson JM, Morris JM. Trends in adverse maternal outcomes during childbirth: a population-based study of severe maternal morbidity. BMC Pregnancy Childbirth. 2009; 9: 7. https://doi.org/10.1186/1471-2393-9-7.
6. Knight M, Callaghan WM, Berg C, Alexander S, Bouvier- Colle MH, Ford JB, et al. Trends in postpartum haemorrhage in high resource countries: a review and recommendations from the International Postpartum Hemorrhage Collaborative Group. BMC Pregnancy Childbirth. 2009;9:55.
7. Kuklina EV, Meikle SF, Jamieson DJ, Whiteman MK, Barfield WD, Hillis SD, et al. Severe obstetric morbidity in the United States: 1998–2005. Obstet Gynecol. 2009;113: 293–9.
8. Callaghan WM, Kuklina EV, Berg CJ. Trends in postpartum haemorrhage: United States, 1994–2006. Am J Obstet Gynecol 2010;202:353.e1-6. https://doi: 10.1016/j.ajog.2010.01.011.
9. Mehrabadi A, Hutcheon JA, Lee L, Liston RM, Joseph KS. Trends in postpartum haemorrhage from 2000 to 2009: a population-based study. BMC Pregnancy Childbirth. 2012;12: 108.
10. Jakobsson M, Gissler M, Tapper AM. Risk factors for blood transfusion at delivery in Finland. Acta Obstet Gynecol Scand. 2013 Apr;92(4):414-20. doi: 10.1111/j.1600-0412.2012.01490.x.
11. Lutomski JE, Byrne BM, Devane D, Greene RA. Increasing trends in atonic postpartum haemorrhage in Ireland: an 11-year population-based cohort study. BJOG. 2012;119:306–14. https://doi.org/10.1111/j.1471-0528.2011.03198.x
12. Callaghan WM, Creanga AA, Kuklina EV. Severe maternal morbidity among delivery and postpartum hospitalizations in the United States. Obstet Gynecol. 2012;120:1029–36.
13. Joseph KS, Rouleau J, Kramer MS, Young DC, Liston RM, Baskett TF; Maternal Health Study Group of the Canadian Perinatal Surveillance System. Investigation of an increase in postpartum haemorrhage in Canada. BJOG. 2007;114:751–9.
14. McLintock C, James AH. Obstetric haemorrhage. J Thromb Haemost 2011;9:1441–51.
15. Al-Zirqi I, Vangen S, Forsen L, Stray-Pedersen B. Prevalence and risk factors of severe obstetric haemorrhage. BJOG. 2008; 115:1265–72.
16. Jou HJ, Hung HW, Yan YH, Wu SC. Risk factors for blood transfusion in singleton pregnancy deliveries in Taiwan. Int J Gynecol Obstet. 2012;117:124–7.
17. Lain SJ, Roberts CL, Hadfield RM, Bell JC, Morris JM. How accurate is the reporting of obstetric haemorrhage in hospital discharge data? A validation study. Aust N Z J Obstet Gynaecol.2008;48:48.
18. Knight M, Callaghan WM, Berg C, Alexander S, Bouvier-Colle MH, Ford JB, et al. Trends in postpartum haemorrhage in high resource countries: a review and recommendations from the International Postpartum Hemorrhage Collaborative Group. BMC Pregnancy and Childbirth. 2009; 9:55. https://doi.org/10. 1186/1471- 2393-9-55.
19. Ford JB, Patterson JA, Seeho SK, Roberts CL. Trends and outcomes of postpartum haemorrhage, 2003–2011. BMC Pregnancy & Childbirth.2015; 15:334.

20. Mehrabadi A, Liu S, Bartholomew S, Hutcheon JA, Kramer MS, Liston RM, et al. Temporal trends in postpartum haemorrhage and severe postpartum haemorrhage in Canada from 2003 to 2010. [Erratum appears in J Obstet Gynecol Can. 2014 Mar;36(3):207]. J Obstet Gynaecol Can. 2014; 36(1):21–33.
21. Patterson JA, Roberts CL, Bowen JR, Irving DO, Isbister JP, Morris JM, et al. Blood transfusion during pregnancy, birth, and the postnatal period. Obstet Gynecol. 2014; 123(1):126–33. https://doi.org/10. 1097/ AOG.0000000000000054 PMID: 24463672
22. Ford JB, Roberts CL, Bell JC, Algert CS, Morris JM. Postpartum haemorrhage occurrence and recurrence: a population-based study. Med J Aust. 2007; 187(7):391–3. PMID: 17908001
23. Oberg AS, Hernandez-Diaz S, Palmsten K, Almqvist C, Bateman BT. Patterns of recurrence of postpartum haemorrhage in a large population-based cohort. Am J Obstet Gynecol. 2014; 210(3):229. e1–8.
24. Wikkelso AJ, Hjortoe S, Gerds TA, Moller AM, Langhoff-Roos J. Prediction of postpartum blood transfusion-risk factors and recurrence. J Matern Fetal Neonatal Med. 2014; 27(16):1661–7. https://doi.org/ 10.3109/14767058.2013.872095 PMID: 24313457.
25. Lawani OL, Iyoke CA, Onyebuchi transfusion trends in obstetrics at the federal teaching hospital in Abakaliki, South-East Nigeria. Int J Women's Health. 2013; 5:407–412.
26. Clark SL, Belfort MA, Dildy GA, Herbst MA, Meyers JA, Hankins GD. Maternal deaths in the 21st century: causes, prevention, and relationship to cesarean delivery. Am J Obstet Gynecol. 2008; 199(1):31–36.
27. Obaid TA. No woman should die giving life. Lancet. 2007;370:1287–1288.
28. Khan KS, Wojdyla D, Say L, Gülmezoglu AM, Van Look PF. WHO analysis of causes of maternal death: a systematic review. Lancet. 2006; 367:1066–1074.
29. Bates I, Chapotera GK, Mckew S, Van Den Broek N. Maternal mortality in sub Saharan Africa: the contribution of ineffective blood transfusion services. BJOG. 2008;115 (11):1331–1339.
30. Kalaivani K. Prevalence and consequences of anaemia in pregnancy. Indian J Med Res. 2009;130:627–633.
31. Jadon A, Bagai R. Blood transfusion practices in obstetric anesthesia. Indian J Anaesth. 2014;58(5):629–636.
32. Lee AI, Okam MM. Anemia in Pregnancy. Hematol Oncol Clin North Am. 2011; 25(2): 241-259.
33. Vichinsky EP. Alpha thalassemia major—new mutations, intrauterine management, and outcomes. Hematology Am Soc Hematol Educ Program. 2009; (1): 35–41. https://doi.org/10.1182/asheducation-2009.1.35.
34. Vinchinsky E. Advances in the treatment of alpha thalassemia. Blood Reviews. 2012; 265(1): S31–S34.
35. Wetherill D. The definition and epidemiology of non - transfusion dependent thalassemia. Blood Reviews. 2012; 265(1): S3–S6.
36. Paxton A, Maine D, Freedman L, Fry D, Lobis S. The evidence for emergency obstetric care. Int J Gynecol Obstet. 2005; 88: 181-193.
37. Walker RH. Special report: transfusion risks. Am J Clin Pathol. 1987; 88: 374- 378.
38. Fastman BR, Kaplan HS. Errors in transfusion medicine: have we learned our lesson? Mt Sinai J Med. 2011; 78: 854-864.
39. Prevention of Postpartum Hemorrhage Initiative, 2011, http://www.pphprevention.org/pph.php.
40. Balki M, Dhumne S, Kasodekar S, Seaward G. Blood transfusion for primary postpartum hemorrhage: a tertiary care hospital review. J Obstet Gynaecol Can. 2008; 30(11):1002–07.
41. Drife J. Management of primary postpartum haemorrhage. Br Jn Obs Gyn. 1997; 104(3): 275-77.
42. James AH, Paglia MJ, Gernsheimer T, Grotegut C. Blood component therapy in postpartum hemorrhage. Transfusion 2009; 49(11): 2430-33.

43. The Ministry of Health, Labour and Welfare in Japan, 2011, http://winet.nwec.jp/toukei/save/xls/L100220.xls
44. Kamei Y, Kubo T, Yano T. Hypovolemic shock in obstetrics— the present state and the management. Obstetrical and Gynecological Therapy.2009; 99(3): 2793.
45. Allen LH. Anemia and iron deficiency: effects on pregnancy outcome. Am J Clin Nutr 2000; 71(5):1280-84.
46. Johnson U, Gustavi B. Complement components in normal pregnancy. Acta Pathol Microbiol Immunol Scand C. 1987; 95:97–99.
47. Hopkinson ND and Powell RJ. Classical complement activation induced by pregnancy: Implications for management of connective tissue diseases. J Clin Pathol. 1992;45:66–67.
48. Carroll MC. The complement system in regulation of adaptive immunity. Nat Immunol. 2004; 5:981–86.
49. Regan F and Taylor C. Blood transfusion medicine. BMJ. 2002; 325(7356):143 47.
50. SHOT annual report and summary 2009.
51. Handbook of Transfusion Medicine, UK Blood Transfusion and Tissue Transplantation Services Jan 2007.
52. BCSH Blood Transfusion Task Force.Guidelines on gamma irradiation of blood components for the prevention of transfusion-associated graft-versus-host disease. transfusion medicine. 1996:6(3):261–71.
53. Gorlin JB, Mintz PD. Transfusion-associated graft-vs-host disease. In Mintz PD. Transfusion Therapy: clinical principles and practices, 2nd ed. Bethesda, MD: AABB Press. 2005: 579-595.
54. https://webpath.med.utah.edu/TUTORIAL/BLDBANK/BBTXRXN.html.
55. https://www.ncbi.nlm.nih.gov/books/NBK448158.
56. https://emedicine.medscape.com/article/206885-clinical#b5.
57. https://www.openanesthesia.org/febrile_transfusion_reaction.
58. https://gpnotebook.com/simplepage.cfm?ID=x20161228153754191130.
59. https://www.ausmed.com/cpd/articles/blood-transfusion-reactions.
60. https://www.labce.com/spg404296_febrile_nonhemolytic_transfusion_reactions_definit6.
61. Khan KS, Wojdyla D, Say L, Gulmezoglu AM, Van Look PF. WHO analysis of causes of maternal death: a systematic review. Lancet. 2006; 367(9516): 1066- 1074.
62. Ekeroma AJ, Ansari A, Stirrat GM. Blood transfusion in obstetrics and gynaecology. Br J Obstet Gynecol. 1997;104 (3):278-284.
63. Mhyre JM, Shilkrut A, Kuklina EV, et al. Massive blood transfusion during hospitalization for delivery in New York State, 1998-2007. Obstet Gynecol. 2013;122(6):1288-1294.
64. Kramer MS, Berg C, Abenhaim H, et al. Incidence, risk factors, and temporal trends in severe postpartum hemorrhage. Am J Obstet Gynecol. 2013; 209(5): 449.e1-7.
65. Balki M, Dhumne S, Kasodekar S, Carvalho JCA, Seaward G. Blood transfusion for primary postpartum hemorrhage: a tertiary care hospital review. J Obstet Gynaecol Can. 2008;30(11):1002-1007.
66. Kuehnert MJ, Basavaraju SV, Moseley RR, et al. Screening of blood donations for Zika virus infection - Puerto Rico, April 3-June 11, 2016. MMWR Morb Mortal Wkly Rep. 2016;65(24):627-628.
67. Zou S, Stramer SL, Dodd RY. Donor testing and risk: current prevalence, incidence, and residual risk of transfusion -transmissible agents in US allogeneic donations. Transfus Med Rev. 2012;26(2):119-128.
68. Bolton-Maggs PHB. Serious hazards of transfusion - conference report: celebration of 20 years of UK haemovigilance. Transfus Med. 2017;27(6): 393-400.
69. Delaney M, Wendel S, Bercovitz RS, et al; Biomedical Excellence for Safer Transfusion (BEST) Collaborative. Transfusion reactions: prevention, diagnosis, and treatment. Lancet. 2016;388(10061):2825-2836.

70. Savage WJ. Transfusion reactions. Hematol Oncol Clin North Am. 2016;30(3):619-634.
71. Sanders RP, Maddirala SD, Geiger TL, et al. Premedication with acetaminophen or diphenhydramine for transfusion with leucoreduced blood products in children. Br J Haematol. 2005;130(5):781-787.
72. Paglino JC, Pomper GJ, Fisch GS, Champion MH, Snyder EL. Reduction of febrile but not allergic reactions to RBCs and platelets after conversion to universal prestorageleukoreduction. Transfusion. 2004;44(1):16-24.
73. Rogers MA, Rohde JM, Blumberg N. Haemovigilance of reactions associated with red blood cell transfusion: comparison across 17 countries. Vox Sang. 2016;110(3):266-277.
74. Koussi A, Trachana M, Pliaki P, Gombakis N, Athanassiou-Metaxa M. Transfusion related acute lung injury syndrome (TRALI) in a patient with thalassaemia. Pediatr Blood Cancer. 2006;46(7):829-830, author reply 831.
75. Pham HP, Shaz BH. Update on massive transfusion. Br J Anaesth. 2013;111(suppl 1):i71-i82.
76. Curtis BR, McFarland JG. Mechanisms of transfusion-related acute lung injury (TRALI): anti-leukocyte antibodies. Crit Care Med. 2006;34(5 suppl): S118-S123.
77. Triulzi DJ, Kleinman S, Kakaiya RM, et al. The effect of previous pregnancy and transfusion on HLA alloimmunization in blood donors: implications for a transfusion-related acute lung injury risk reduction strategy. Transfusion. 2009;49(9):1825-1835.
78. Cerci Gurbuz B, Soyoz M, OzkaleOkyay D, KilicaslanAyna T, Pirim I. Comparison of anti-HLA antibody production according to gestational periods in pregnant women. Transplant Proc. 2017;49(3):464-466.
79. Guleria I, Sayegh MH. Maternal acceptance of the fetus: true human tolerance. J Immunol. 2007;178(6):3345-3351.
80. De Cripple D, Baeten M, Torfs A, et al. Screening for HLA antibodies in plateletpheresis donors with a history of transfusion or pregnancy. Transfusion. 2014;54(12):3036-3042.
81. Mehra T, Seifert B, Bravo-Reiter S, Wanner G, Dutkowski P, Holubec T, Moos RM, Volbracht J, Manz MG, Spahn DR. Implementation of a patient blood management monitoring and feedback program significantly reduces transfusions and costs. Transfusion. 2015; 55(12):2807–2815. https://doi.org/10.1111/trf.13260.
82. Gross I, Seifert B, Hofmann A, Spahn DR. Patient blood management in cardiac surgery results in fewer transfusions and better outcome. Transfusion. 2015; 55(5):1075–1081. https://doi.org/10.1111/trf.12946.
83. Goodnough LT, Maggio P, Hadhazy E, Shieh L, Hernandez- Boussard T, Khari P, Shah N. Restrictive blood transfusion practices are associated with improved patient outcomes. Transfusion. 2014; 54(10 Pt 2):2753–2759. https://doi.org/10.1111/ trf.12723.
84. Keding V, Zacharowski K, Bechstein WO, Meybohm P, Schnitz- Bauer AA. Patient Blood Management improves outcome in oncologic surgery. World Surg Oncol. 2018; 16(1):159. https://doi.org/10.1186/s12957-018-1456-9.
85. Meybohm P, Richards T, Isbister J, Hofmann A, Shander A, Goodnough LT, Munoz M, Gombotz H, Weber CF, Choorapoi- Kayil S, Spahn DR, Zacharowski K. Patient Blood Management Bundles to Facilitate Implementation. Transfus Med Rev. 2017; 31(1):62–71. https://doi.org/10.1016/j.tmrv.2016.05.012.
86. Theusinger OM, Kind SL, Seifert B, Borgeat L, Gerber C, Spahn DR. Patient blood management in orthopaedic surgery: a four-year follow-up of transfusion requirements and blood loss from 2008 to 2011 at the Balgrist University Hospital in Zurich, Switzerland. Blood Transfus. 2014; 12(2):195–203. https://doi. orgorg/10.2450/2014.0306-13.
87. Leahy MF, Hofmann A, Towler S, Trentino KM, Burrows SA, Swain SG, Hamdorf J, Gallagher T, Koay A, Geelhoed GC, Farmer SL. Improved outcomes and reduced costs associated with a health-system-wide patient blood management program: a retrospective observational study in four major adult tertiary-care hospitals. Transfusion.

2017; 57(6):1347–1358. https://doi. orgorg/10.1111/trf.14006.

88. Roubinian NH, Escobar GJ, Liu V, Swain BE, Gardner MN, Kipnis P, Triulzi DJ, Gottschall JL, Wu Y, Carson JL, Kleinman SH, Murphy EL. Trends in red blood cell transfusion and 30-day mortality among hospitalized patients. Transfusion. 2014; 54(10 Pt 2):2678–2686. https://doi.org/10.1111/trf.12825.
89. Trentino KM, Farmer SL, Swain SG, Burrows SA, Hofmann A, Ienco R, Pavey W, Daly FF, Van Niekerk A, Webb SA, Towler S, Leahy MF. Increased hospital costs associated with red blood cell transfusion. Transfusion. 2015; 55 (5):1082– 1089. https://doi. orgorg/10.1111/trf.12958.
90. Althof FC, Neb H, Herrmann E, Trentino KM, Vernich L, Ful- Lenbach C, Freedman J, Waters JH, Farmer S, Leahy MF, Zacha- Rowski K, Meybohm P, Choorapoikayil S. Multimodal patient blood management program based on a three-pillar strategy: a systematic review and meta-analysis. Ann Surg. 2019 May; 269(5):794-804. https:// doi.org/10.1097/sla.0000000000003095.
91. WHO. WHA63.12 availability, safety and quality of blood products. WHA resolution the sixty-third world health assembly. WHO, Geneva. 2010.
92. Munoz M, Gomez-Ramirez S, Kozek-Langeneker S, Shander A, Richards T, Pavia J, Kehlet H, Acheson AG, Evans C, Raobai- Kady R, Javidroozi M, Auerbach M. 'Fit to fy': overcoming barriers to preoperative haemoglobin optimization in surgical patients. Br J Anaesth. 2015; 115(1):15–24. https://doi.org/10.1093/bja/aev165.

ARTICLE TYPE: Review Article; **ORCID ID:** Open Researcher and Contributor Identifier (ORCID) ID of corresponding author: https://orcid.org/0000-0002-7366-2529; **ETHICAL:** NA; **ACKNOWLEDGEMENT:** None; **FINANCIAL DISCLOSURE:** The authors declare that there was no financial aid received.; **CONFLICT OF INTEREST:** No conflict of interest associated with this review work.; **AUTHORS CONTRIBUTION:** All authors discussed the reviews and prepared the manuscript; **CORRESPONDING AUTHOR AFFILIATIONS:** Darla Srinivasarao. Assistant Professor, School of Medical and Allied Sciences, Division of Medical Lab Technology, Galgotias University, Greater Noida, India.; **CORRESPONDING AUTHOR EMAIL:** darla.srinivasa@galgotiasuniversity.edu; **ARTICLE CITATION:** Kumar PY, Srinivasarao D, Sharma B, Mahto BK. Review on blood transfusion during pregnancy and postnatal period. SALT J Sci Res Healthc. 2021 February 11; 1(1): 01-04.

PUBLISHER'S NOTE: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.