International Journal of Medical Toxicology & Legal Medicine **Volume 27, No. 2S, 2024**
e-ISSN: 0974-4614
p-ISSN: 0972-0448

Blood transfusion in obstetrics

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Received: 11.10.2024 Revised: 16.11.2024 Accepted: 26.11.2024

ABSTRACT
Severe hemodynamic instability is caused by several pregnancy problems and labor abnormalities, which also act as triggers for additional blood loss throughout pregnancy. In the routine practice of obstetrics, this, with complications from induced or spontaneous abortion & ruptured ectopic pregnancy, manifests as illnesses requiring transfusion. Several prevalent risk factors contribute to the necessity for transfusions of blood and its components throughout labor and pregnancy, including placental complications (abruption, previa, retained placenta, accreta), uterine overdistension (polyhydramnios, multiple gestation), labor augmentation, preterm labor. Preeclampsia, disseminated intravascular coagulation (DIC), and operative delivery—either abdominal or vaginal. Blood transfusions are sometimes criticized as being too late" or "too little in retrospective clinical assessments. Conversely, numerous gynecological illnesses, including uterine or cervical malignancies, fibroid uterus, operations, and dysfunctional hemorrhaging, may result in anemia and necessitate blood & component transfusions in females. Surgical techniques in gynecology require the optimization of hemoglobin before surgery. Components of blood designated for transfusion are generally harvested as anticoagulated total blood (450 milliliters). The majority of donated blood is differentiated into compartments: platelets, packed red blood cells, & fresh frozen plasma (FFP) or cryoprecipitate.

Keywords: Blood Transfusion; Obstetrics; Hemodynamic

1. INTRODUCTION

Severe hemodynamic instability is caused by several pregnancy problems and labor abnormalities, which also act as triggers for additional blood loss throughout pregnancy. In the routine practice of obstetrics, this, with complications from induced or spontaneous abortion & ruptured ectopic pregnancy, manifests as illnesses requiring transfusion. In obstetrics, the reported rate of transfusion ranges from 0.16 to 2–6%. Females who have abnormal labors and births have higher rates. Additionally, rates of transfusion vary and exhibit regional variety, as well as variations in clinician and hospital practices. (1).

Research indicates that surgical specialists & junior doctors are more prone to administer blood transfusions to cases compared to anesthesiologists and physicians. In recent years, there has been a tendency to diminish the utilization of blood transfusions in obstetrics. This was confirmed by research publications in this field. This reduction in transfusion has transpired despite the increase in surgical delivery rates at multiple hospitals. Although blood transfusion rates have declined, obstetric outcomes have gotten better. The prevalent etiologies for pregnancy-related cases needing transfusion include: (2)

- Bleeding following surgery
- Multisystem inflammatory syndrome
- Abruption placenta
- Preeclampsia
- Anemia
- First Trimester blood loss

Several prevalent risk factors contribute to the necessity for transfusions of blood and its components throughout labor and pregnancy, including placental complications (abruption, previa, retained placenta, accreta), uterine

overdistension (polyhydramnios, multiple gestation), labor augmentation, preterm labor, preeclampsia, disseminated intravascular coagulation (DIC), and operative delivery—either abdominal or vaginal. (3).
Transfusion practices were marred by difficulties, including whole blood versus component utilization, single-unit versus multiple-unit transfusions, differing massive transfusion protocols, and medical judgment against "trigger" hemoglobin levels for transfusion, resulting in different reports. (4).

EPIDEMIOLOGY
Obstetric bleeding is the primary etiology of the death of mothers, with rates varying from thirteen percent in developed economies to over thirty-four percent in developing countries. Obstetric bleeding may happen either before or following birth; nevertheless, more than eighty percent of occurrences take place during the time following delivery, accounting for twenty-five percent of the approximately 358,000 maternal fatalities annually.(5)**.**
Additional conditions, including placental abruption, placenta previa, molar pregnancy, ectopic pregnancy, hemolytic anemia, and severe nutritional anemia, may necessitate transfusion therapy. Transfusions of blood are a critical element of emergency obstetric treatment, and the correct administration of transfusions of blood significantly decreases the death of mothers. Transfusion indications in obstetrics can be both emergent and nonemergent; nonetheless, the core concept of transfusion treatment is that it must be suitable(6)**.**
Blood transfusions are sometimes criticized as being too late" or "too little in retrospective clinical assessments. Conversely, numerous gynecological illnesses, including uterine or cervical malignancies, fibroid uterus, operations, and dysfunctional hemorrhaging, may result in anemia and necessitate blood & component transfusions in females. Surgical techniques in gynecology necessitate the optimization of hemoglobin before surgery. (7)**.**
While a blood transfusion can be lifesaving, its risks must be considered. Recipients may infrequently encounter immunological adverse effects such as red cell alloimmunization or transfusion-related infection transmission; therefore, appropriate care must be exercised. Transfusion rules were established by multiple organizations across different nations (8)**.**

Various Compartment of TransfusionofBlood
Components of blood designated for transfusion are generally harvested as anticoagulated total blood (450 milliliters). The majority of donated blood is differentiated into compartments: platelets, packed red blood cells, & fresh frozen plasma (FFP) or cryoprecipitate. Total blood is initially divided into packed red blood cells & platelet-rich plasma through gradual centrifugation. The platelet-rich plasma is further rotating at high velocity to produce one unit of random donor (RD) platelets & single unit of fresh frozen plasma. Cryoprecipitate is generated by melting fresh frozen plasma to precipitate plasma proteins, followed by isolation through centrifugation. (9)**.**
Whole Blood: It is maintained at forty degrees Celsius to preserve erythrocyte viability. This component is optimal for cases who had an acute hemorrhage (blood loss above twenty-five percent of the total volume of blood), as it enhances oxygen-carrying capacity & facilitates expansion of the volume of blood. (10)**.**

Drawbacks of total blood are: (11)
- dysfunction of platelets & the breakdown of certain clotting variables happen within twenty-four to forty-eight hours of storage.
- Levels of two or three DPG may decline by thirty percent in blood held for over two weeks and by sixty to seventy percent in 3 weeks, significantly decreasing the capability to deliver O_2 to tissues.

Packed Red Blood Cells (PRBC): This is accomplished by extracting two hundred cubic centimeters of plasma from fresh total blood to attain a final hematocrit of seventy to eighty percent. They are maintained in a liquid state at four degrees Celsius or preserved in a frozen state at minus eighty degrees Celsius. It is maintained in an anticoagulated state using CPD (phosphate, citrate, dextrose). The rate of survival of blood cells diminishes from ninety percent with rapid transfusion to sixty-five percent after 6 weeks of storage. Universal pre-storage leukocyte decrease in packed red blood cells is advised to mitigate adverse effects, including cytomegalovirus (CMV) infections, post-transfusion fever, and alloimmunization. Prestorage filtration is more effective than bedside filtration as it produces a reduced amount of cytokines in the stored product. (12)**.**

Cryopreserved RBC: This method uses the fast cooling of packed red blood cells to minus eighty degree Celsius using forty percent glycerol. The level of DPG is within the usual range. This approach exhibits little antigenic responses. Significant volumes of red blood cells can be preserved for a long time. However, elevated costs represent a significant drawback. (13)**.**

Platelets: It is obtained through successive centrifugation of fresh total blood & resuspension in thirty to fifty cubic centimeters of plasma at twenty-two degrees Celsius. It remains effective for up to 5 days and is most

potent if utilized within twenty-four to forty-eight hours of pooling, as it gradually loses its capability to create thromboxane A-2, a powerful platelet aggregator & vasoconstrictor, throughout the five-day period. It must be Rh & ABO compatible because of the presence of donor plasma. The probability of infectious problems correlates with the several donors. (14)**.**

Apheresis technology is utilized to obtain numerous platelet units from a single donor. Single-donor apheresis platelets (SDAP) comprise equal of minimum of six units of random-donor platelets & possess a reduced quantity of contaminating leukocytes compared to pooled random-donor platelets. (15)**.**

The criteria for prophylactic transfusion of platelets are ten thousand per milliliter. In cases without fever or illnesses, a threshold of five thousand per milliliter may suffice to prevent spontaneous bleeding. The standard target threshold for invasive operations is five thousand per milliliter. (16)**.**

Platelets are administered either as single-donor apheresis platelets or as pools derived from 5 to 8 random-donor platelets. In a non-sensitized case with no elevated platelet consumption, 6–8 units of RD platelets (about one unit per ten kilograms of body weight) are transfused, with all units expected to elevate the count of platelets by five thousand to ten thousand per milliliter. Cases undergoing several transfusions typically become alloimmunized to various platelet-specific antigens & human leukocyte antigens, resulting in minimal or no enhancement of their following platelet count transfusion. Cases necessitating multiple transfusions are optimally supported by single-donor apheresis platelet & leukocyte-decreased compartments to decrease the possibility of alloimmunization. (17)**.**

Refractoriness to several transfusions can be assessed by the corrected count increment (CCI): corrected count increment = [(post-transfusion count - pre-transfusion count) / number of platelets transfused] x 10^11 x (body surface area measured in square meters) (18)

The count of platelets measured 1h following transfusion is deemed appropriate if the corrected count increment is 10x10^9/milliliter, with an anticipated rise of 7.5x10^9/milliliter following eighteen to twenty-four hours. Cases with inadequate responses are liable to have undergone several transfusions & possess antibodies targeting Class one human leukocyte antigen. Refractoriness can be identified by the presence of anti-human leukocyte antigen antibodies in the serum of recipients. These cases are optimally supported by single-donor apheresis platelets if necessary. (19)**.**

Fresh Frozen Plasma: Fresh frozen plasma comprises elements of the fibrinolytic, coagulation, & complement systems. It is derived from one donor. It is frozen at minus eighty degrees Celsius, a condition that primarily preserves Factors V &VII. It presents an equivalent probability of hepatitis &HIV as packed red blood cells. It is effective in addressing deficits in vitamins two, five, seven, eight, nine, ten, and eleven, as well as in reversing Coumarin and treating antithrombin III insufficiency. Type & Rh-specific plasma must be utilized. Urticaria & deadly pulmonary edema may manifest. Plasma can also be obtained using apheresis. Derivatives of plasma, including coagulation factors, antithrombin, albumin, & intravenous immunoglobulin, are derived from pooled plasma from several donors & are processed to eradicate infectious pathogens. (20)**.**

Cryoprecipitate: It is utilized to replenish fibrinogen, or Factor VIII. It is constituted as a plasma concentrate predominantly comprising fibrinogen and Factor VIII. Furthermore, it includes Factor XIII, von Willebrand factor, & fibronectin. It is maintained at thirty-seven degrees Celsius, as elevated temperatures degrade Factor VIII. The primary drawback is the higher probability of hemolytic responses resulting from residual anti-B, anti-A, & Rh antibodies present in the preparation, as they are derived from several donors. (21)**.**

Physiological changes in pregnancy

The augmentation of red cell mass (twenty to thirty percent) and a disproportionally higher elevation in plasma volume (fifty percent) assist in maintaining hemodynamic stability amidst the typical blood loss after delivery. Pregnancy is characterized by a hypercoagulable condition, marked by elevated levels of fibrinogen & coagulation factors VIII, VII, & IX, which surpass the increase in natural anticoagulants like Protein C, Protein A, & Antithrombin III. The activity of the fibrinolytic system diminishes. Plasminogen levels are elevated, although its action is suppressed by an associated rise in plasminogen inhibitor type two. An exception to the overall rise in coagulation factors is the decline in platelet counts, known as gestational thrombocytopenia. (22)**.**

Problems in the evaluation of bleeding

Evaluation of hemorrhage by vital signs Observing during pregnancy is unreliable because of the elevated plasma volume of mothers. The relative hemodilution & elevated cardiac output enable significant bleeding in a pregnant woman prior to hypotension & a decrease in hemoglobin/hematocrit (Hct) occurs. The evaluation may be misleading due to significant blood loss potentially being hidden within the uterine cavity. (23)**.**

Comorbid disorders such as thrombocytopenia, preeclampsia, & HELLP syndrome can lead to severe hemorrhage. The hypercoagulable state during pregnancy aids in minimizing blood loss, but it may predispose the mother to disseminated pulmonary embolism & intravascular coagulopathy. (24)**.**

Risk to the fetus

During the management of acute hemorrhagic emergencies, it is essential to consider the fetus to avoid infections & prevent hemolytic disease of the fetus and newborn (HDFN) in both present & subsequent pregnancies. (25)**.**

Indications Of Transfusion Of Blood In Obstetrics:(26)

- Doctors where significant bleeding is anticipated.
- Obstetric hemorrhage
- Anemia of pregnancy and Haemoglobinopathies

Transfusion Of Blood For Pregnant Women With Anaemia

Throughout pregnancy, anemia accounts for fifteen percent of the deaths of mothers. Timely correction of anemia prevents the necessity for transfusion & lowers the death of mothers. The choice to transfuse shouldn't depend only on hemoglobin levels, as healthy and clinically stable females don't necessitate blood transfusion even with a hemoglobin of less than seven grams per deciliter. In conclusion, transfusion is required if hemoglobin is less than six grams per deciliter and delivery is imminent within four weeks. (22)**.**

Blood transfusion is warranted when hemoglobin falls below seven grams per deciliter during labor or immediately following delivery, but only if there is a prior history of hemorrhage or the case is predisposed to hemorrhage because of a medical condition. Transfusion is warranted if hemoglobin is seven grams per deciliter, for females having continuous bleeding or at danger of significant bleeding, or for those exhibiting severe symptoms requiring prompt intervention (cardiac decompensation). Transfusions in cases with sickle cell disease & thalassemia should be limited to severe cases, as prophylactic transfusions are related to elevated costs, increased hospitalizations, and an elevated probability of alloimmunization. (27)**.**

Transfusion OF Blood in Major Obstetrics Bleeding

Although the possibilities are related to transfusions, obstetricians often exhibit excessive aggression in administering blood & products of blood to their cases. Acute bleeding in obstetrics is typically because of placenta previa, bleeding after delivery, & surgical interventions. This needs the prompt involvement of a consultant obstetrician, anesthesiologist, hematologist, & the blood bank. No clear criteria exist for starting transfusions of red cells. Decisions must be predicated on clinical & hematological variables. (28)**.**

- Transfusion is recommended when the packed cell volume (PCV) is below twenty-one percent in cases without cardiac disease, and it is typically administered at a ratio of 3 volumes of crystalloid to one blood volume. In cases of acute shock, this ratio may escalate to 8:1. (29)**.**
- Administration of FFP must be considered before the loss of one blood volume.
- Fibrinogen insufficiency is the initial hemostatic defect observed when packed red blood cell concentrates are utilized to compensate for significant bleeding. Clinically severe fibrinogen lack occurs following a reduction of around 150 percent of the volume of blood. (30)**.**
- The platelet count must not decrease under 50 x 10^9/milliliters in cases with acute hemorrhage. A platelet transfusion threshold of 75 x 10^9/milliliters is advised to ensure a safety margin. A platelet count of 50 x 10^9/milliliters may be expected after the replacement of about two blood volumes with fluids or red cell components. (31)**.**
- Anti-Rh D (250 International Units) is required if the platelets are Rh D (+) & the recipient is Rh D (-). This is unnecessary if a cesarean hysterectomy was conducted. (32)**.**
- The fresh frozen plasma and cryoprecipitate must preferably match the recipient's blood group. If obtainable, fresh frozen plasma from a distinct ABO group is permissible if it doesn't exhibit high activity of titre anti-B or anti-A. Anti-D prophylaxis is unnecessary for a Rh D (-) female receiving Rh D-positive fresh frozen plasma or cryoprecipitate. (33)**.**
- In a blood loss lady with disseminated intravascular coagulation, a combination of platelets, fresh frozen plasma , & cryoprecipitate is suggested. (34)**.**
- Fibrinogen concentrations must be sustained over one gram per liter with the administration of fresh frozen plasma. (19)**.**
- The main etiology of coagulopathy with significant blood loss is the dilution of coagulation factors due to volume replacement with colloid or crystalloid solutions & the transfusion of components of red blood cells. (35)**.**
- Females subjected to prolonged hypovolemia, hypoxia, or hypothermia (such as due to insufficient resuscitation), placental abruption, amniotic fluid embolism, & pre-eclampsia are at risk of disseminated intravascular coagulation. If disseminated intravascular coagulation is highly suspected in these females & coagulation investigations are delayed, the transfusion of fresh frozen plasma must be contemplated before obtaining results, particularly if hemorrhage proves difficult to manage. (36)**.**

- DIC must be considered when there is significant hemorrhage from the trauma site & oozing from venipuncture & intravenous line insertion locations. There isn't data to support transfusion triggers for clotting factors; nonetheless, standard treatment involves administering FFP at a dosage of twelve to fifteen milliliters per kilogramto maintain activated partial thromboplastin time (aPTT) & prothrombin time ratios below 1:5. (37)**.**
- The administration of rFVIIa (recombinant factor VIIa) may be provided as a therapeutic option for life-threatening following-delivery bleeding; however, it should not replace lifesaving procedures such as embolization or operations, which must be executed promptly, or the case should be transferred to a referral center for such procedures. (38)**.**
- Transfusion of blood from stored blood induces neutrophil cytotoxicity, which is now recognized as a principal mechanism in multiple organ failure (MOF), with early transfusion identified as a significant independent indicator for multiple organ failure. In cases of acute blood loss with moderate hemorrhagic shock, either Ringer's lactate or normal saline could be utilized for volume replacement; however, in cases of severe hemorrhagic shock, Ringer's lactate is preferred. (39)**.**

Colloids were mainly substituted by crystalloids because of the tendency of the former to escape via permeable capillary membranes, exacerbating edema & compromising tissue oxygenation. Nonetheless, significant amounts of crystalloids were associated with the development of adult respiratory distress syndrome & abdominal compartment syndrome, conditions that colloids mightn't induce; nevertheless, crystalloids eventually provide the greatest survival advantage. (40)**.**

General Rules of Transfusion of Blood in Obstetric case: (41)

- Red cell alloimmunization is most probable during the final trimester; hence, no pre-transfusion sample must exceed seven days in age & must preferably be freshly obtained.
- Only Kell-negative blood is to be utilized for transfusions in females of reproductive age due to the elevated possibility of alloimmunization & subsequent hemolytic illness of the infant, unless the females are confirmed to be Kell-positive.
- Pre-autologous deposits are contraindicated during pregnancy.
- Cell salvage must be utilized exclusively by healthcare teams that utilize it often and possess the requisite competence & experience.
- Should the hemoglobin level fall below seven grams per deciliter during labor or the early following delivery duration, the choice to administer a transfusion must be based on the person's medical history, age, & clinical symptoms.
- In the postnatal period, if hemoglobin levels fall below seven to eight grams per deciliter and there is no continuing or imminent bleeding, the choice to administer a transfusion must be taken on an informed, case-by-case basis. In fit, healthy, asymptomatic cases, there is less proof supporting the advantages of blood transfusion.
- In the event of unforeseen severe hemorrhaging after birth, postnatal studies should be conducted to exclude blood loss diathesis. These examinations must be conducted on a non-urgent basis with a minimum of three to six months post-delivery.

Complications In Transfusion Of Blood: (42)

- Blood transfusion may be lifesaving, although it isn't devoid of risks. Recipients may get transfusion-transmitted infections or certain immunological sequelae, like red cell alloimmunization in rare cases. Consequently, appropriate administrative protocols, and sampling, & must be addressed in emergency situations.
- Acute hemolytic responses arise from the immune-mediated destruction of transfused red blood cells. The breakdown of donor red blood cells transpires within twenty-four hours, with an incidence rate of one in fifty thousand transfusions.
- Allergic reactions can vary from mild urticaria to severe anaphylaxis. These reactions transpire in between one and three percent of transfusions & are elicited by proteins present in the donor plasma.
- Transfusion-related acute lung injury (TRALI) is a noncardiac pulmonary edema that manifests within six hours post-transfusion. Donor products from multiparous females have been related to TRALI & are the primary etiology of post-transfusion death.
- Febrile nonhemolytic transfusion response is characterized by an elevation in body temperature occurring within twenty-four hours post-transfusion. The suggested process involves the production of endogenous cytokines or pyrogens. These effects are mitigated with the utilization of leukodepleted blood products.
- Circulatory overload frequently occurs in females who have anemia, particularly after a fast transfusion. Symptoms consist of cough, tachycardia, hypertension, and dyspnea. The treatment involves diuretics. Prevention involves transfusing minimal amounts of packed red blood cells at a gradual rate.

- Transfusion-related graft versus host illness is a delayed reaction in which donor lymphocytes proliferate & launch an acute assault on the recipient's tissues. It occurs in immunocompromised cases & is associated with an elevated death rate. Prevention involves the utilization of leukodepleted or irradiated blood components.

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