Bassett Healthcare Network

Network Transfusion Guidelines for Blood Products in the Bassett Healthcare Network v1.0
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1.0	Approved and Current	Initial version	12/1/2023	12/6/2023	Indefinite

Bassett Healthcare Network Blood Transfusion Guidelines
A Clinical Summary

DOCUMENT CONTENTS

LEUKOREDUCED RED BLOOD CELLS

OVERVIEW:

The majority of red blood cell components are derived from single donor collections, which, after plasma has been removed, are referred to as Red Blood Cells. Although there are several types of storage solutions, most units are manufactured with additive solutions (AS-1, AS-3, AS-5, or AS-7) that enhance storage conditions. These units have a final hematocrit of between 55% and 65%, a volume of between 300-400 mL, and a shelf life of 42 days.

AVAILABILITY:

All network transfusion services maintain a stock of Red Blood Cells of various ABO and Rh groups. O Negative units are available for emergency transfusion when the patient's ABO/Rh status is unknown.

INDICATIONS:

Red Blood Cells are used for the treatment of symptomatic anemia or in cases of clinically significant red blood cell loss due to hemorrhage, increased red cell destruction (hemolytic anemias) or decreased red cell production (e.g., marrow failure due to leukemia, chemotherapy, or radiation). Red Blood Cells are also used in the setting of exchange transfusions (either manual or with the use of apheresis), particularly in patients with hereditary hemoglobinopathies.

CONTRAINDICATIONS:

Transfusion is relatively contraindicated if the anemia can be corrected with other specific modalities, such as iron, vitamin B_{12}, folic acid, or erythropoietin. Also, red blood cell transfusion should not be used solely for volume expansion or to provide increased oncotic pressure, which is typically treated with crystalloid or colloid solutions.

DOSAGE:

Transfusion of one unit of Red Blood Cells typically increases serum hemoglobin concentration by approximately 1 g/dL and hematocrit by 3% in the average adult. Except in the setting of resuscitation for active bleeding, transfusion should be given as single units.

RECOMMENDATIONS:

Foremost, the use of *only* hemoglobin level as a "transfusion trigger" is strongly condemned in most published guidelines. The decision to transfuse a patient needs to be based not only on hemoglobin levels, but the patient's overall clinical status, which may include: the patient's age and performance status; co-morbidities, particularly CHF, COPD, valvular heart disease, and ischemic heart disease; whether there is active bleeding or brisk red blood cell destruction; whether and to what degree the patient is symptomatic; and whether the patient has increased metabolic demands, such as with postoperative, trauma, or burn patients.

In general, in adult hospitalized patients, red cell transfusion for the treatment of anemia is indicated:

Clinical Status:	Hemoglobin Level:
hemodynamically stable, without evidence of symptomatic anemia	7 g/dL or less
hemodynamically stable, immediately post-operative or perioperative	8 g/dL or less
pre-existing cardiovascular and/or pulmonary disease with evidence of symptomatic anemia - e.g., chest pain, orthostatic hypotension, tachycardia unresponsive to volume correction, congestive heart failure	8 g/dL or less

Broadly, transfusion is indicated when a patient's hemoglobin is less than 6-7 g/dL and rarely, if ever, indicated when 10 g/dL or more. Similar recommendations may be used with patients in the outpatient setting.

SPECIAL CONSIDERATIONS:

1. Acute Coronary Insufficiency:

No generally well-recognized recommendations are available for this patient population, although many experts *tend* to recommend consideration of transfusion with hemoglobin concentrations of 10 mg/dL or less with close monitoring of the patient's volume, cardiac, and tissue oxygenation status.

2. Active Bleeding:

In the setting of active bleeding, which may be due to trauma, GI hemorrhage, or surgery, the decision to transfuse may be based on the estimated degree of blood loss:

Estimated Blood Loss | Volume	Classification	Treatment Recommendations
> 15% | <750 mL	Class I	Volume resuscitation with crystalloid only; red blood cell transfusion generally not indicated

15-30% | 750-1500 mL	Class II	Volume resuscitation with crystalloid and/or colloid; red blood cell transfusion is rarely indicated, particularly with young, otherwise healthy patients
30-40% | 1500-2000 mL	Class III	Rapid volume resuscitation with crystalloids and colloids; red blood cell transfusion is probably necessary
>40% | >2000 mL	Class IV	Blood loss of 40% or greater is usually life-threatening; rapid volume replacement, including red blood cell transfusion, is required

Alternatively, transfusion may be based on the patient's hemoglobin concentration, although the accuracy of serum hemoglobin may be affected by the rapidity of blood loss and/or the effect of dilution due to volume resuscitation with crystalloid or colloid solutions.
The American Society of Anesthesiologists Task Force on Blood Component Therapy offers the following recommendations for transfusion based on hemoglobin concentration:

Hemoglobin Concentration	Treatment Recommendation
Hgb > 10 g/dL	red blood cell transfusion is rarely indicated
Hgb 6-10 g/dL	red blood cell transfusion is based on the patient's risk of ischemia from ongoing bleeding and/or other high-risk factors
Hgb < 6 g/dL	red blood cell transfusion is almost always indicated

Importantly, particularly in cases of *rapid bleeding*, red cell transfusion may be based on clinical parameters such as hypotension, tachycardia, diaphoresis, confusion or mental status changes, restlessness, air hunger, decreased urine output, or other stigmata of inadequate perfusion, regardless of the current laboratory values.
These factors, coupled with an assessment of the risk of ongoing bleeding (e.g., extent of trauma, site of bleeding, body temperature, presence of coagulopathies, etc.) should guide transfusion decision making.

3. Sickle Cell Disease:
In general, the decision to transfuse patients with sickle cell disease with or without other hemoglobinopathies (e.g., Hgb SS disease, Hgb SC disease, patients with Hgb S-thalassemia, etc.) requires assessment of their current clinical status, hemoglobin concentration, and the percentage of Hgb S. These patients may be at particular risk of stroke, acute chest syndrome, or other serious sequelae of their disease and many of these are on a program of chronic transfusion, which may be simple or exchange type transfusion.
In general, exchange transfusion attempts to maintain a hematocrit of approximately 30% and a hemoglobin S concentration of 30% or less.

Selection of Units for the Sickle Cell Disease Patient:

a) Red cell products for patients with known Sickle Cell Disease should be negative for Hemoglobin S and antigen matched for the patient's Rh and Kell Blood Group antigens.

b) If an alloantibody is detected from any other blood group system, red cell products must be antigen negative for these as well.

4. Patient's with unexpected alloantibodies:

If a patient has been identified as having an unexpected antibody, specificity is determined and clinical significance assessed. A clinically significant red cell antibody is defined as an antibody that is frequently associated with hemolytic disease of the fetus and newborn, hemolytic transfusion reaction or a notable decrease in transfused red cell survival. If a patient has a clinically significant unexpected alloantibody or history of a previously identified clinically significant antibody, blood selection should be antigen negative for the antibody identified.

a) If the alloantibody identified is an antibody to one or more of the Rh blood group antigens C, c , E, or e, blood is routinely selected that matches the patient's Rh (C,c,E,e) phenotype.

b) If a patient has developed more than one antibody and is a candidate for multiple future transfusions (Cancer Treatment Center or Dialysis patient), phenotypically matched units are recommended to prevent additional development of alloantibody production.

c) If the antibody identified is a warm autoantibody, the red cell product of choice for transfusion is a "phenotypically" matched unit to prevent alloimmunization of alloantibodies.

5. Burn Patients:

The decision to transfusion in this patient population may be based broadly on their overall clinical status, extent of burns, and whether there is evidence of cardiopulmonary compromise. Broadly, red blood cell transfusion is indicated:

a) in non-critically ill patients, without evidence of cardiopulmonary compromise, with a hemoglobin concentration of 8 g/dL or less.

b) in critically ill patients and/or those with evidence of cardiopulmonary compromise with a hemoglobin concentration of 10 g/dL or less.

APHERESIS PLATELETS

OVERVIEW:

Currently, the majority of platelet units are obtained from single donor apheresis collections and are referred to as Apheresis Platelets.

Pathogen reduction is a post-collection manufacturing process intended to reduce the risk of certain transfusion transmitted infections approved by FDA and manufactured by the American Red Cross and New York Blood Center. Psoralen treatment using amotosalen is a specific pathogen reduction technology used to prepare the apheresis platelets. This technology employs

a combination of UV irradiation and photosensitizers to damage pathogen nucleic acids, preventing replication and growth.

These typically contain $\geq 3.0 \times 10^{11}$ platelets per units in a volume of approximately 200-300 mL. Apheresis platelets are generally stored in ACD-A anticoagulant solution although platelet additive solutions (PAS-C or PAS-F) may also be used. Regardless of collection method or storage solution, platelets have a shelf life of 5 days.

Platelets express ABO antigens on their surface. ABO compatible platelets result in a greater platelet count increment in the recipient, and can be used to improve responses in patients who have become refractory to platelet transfusion due to alloimmuniza tion of ABO mismatched platelets when type-specific platelet products are not available. ABO-incompatible platelets may increase an individual's anti-A and/or anti-B antibody titers, depending on the mismatched A or B antigens which may also stimulate the recipients' immune systems to make other alloantibodies.

Although platelets do not express Rh antigens, platelet products contain small numbers of red blood cells (RBCs), which could be Rh incompatible with the recipient. Thus, when women of childbearing age receive a platelet transfusion, platelets from an Rh negative donor are given to an Rh negative recipient to prevent alloimmunization and hemolytic disease of the newborn.

AVAILABILITY:
Normally, due to a very short shelf life, only the Bassett Medical Center Transfusion Service in the network routinely maintains at least one platelet apheresis product, preferably Pathogen Reduced Platelet Apheresis in its inventory. With elective transfusion, these may be ordered from our regional blood suppliers (American Red Cross or New York Blood Center) on an as-needed basis. In the urgent or emergent setting, expedited procurement may be requested from the blood supplier or - if available - from other regional hospitals. *A delay of at least one hour or greater should be anticipated*.

ABO type specific platelets will be given as product of choice to all Hematology/O ncology patients and ABO type specific/ Rh negative to all Rh negative females of child bearing age. It will be the Blood Bank's responsibility to contact the provider to obtain an alternate transfusion recommendation if:

1. Availability of ABO type specific platelets are not in house or limited in availability from the American Red Cross
2. A Rh negative female is of child bearing age and only Rh positive platelets are available.

INDICATIONS:
Platelet transfusions are typically indicated for patients with:

1. thrombocytopenia
2. dysfunctional platelet disorders (congenital, metabolic, or medication-related)
3. active platelet-related bleeding
4. serious risk of bleeding (prophylactic platelet transfusion)

Patients with certain medical conditions may be particularly prone to bleeding, which include:

1. leukemia
2. myelodysplastic syndrome (MDS)
3. aplastic anemia

4. solid tumors
5. congenital or acquired platelet dysfunction
6. central nervous system trauma
7. serious trauma, particularly in the setting of Massive Transfusion Protocol

Additionally, certain medical procedures may require consideration of platelet transfusion. These include:

1. cardiopulmonary bypass
2. extracorporeal membrane oxygenation (ECMO)

CONTRAINDICATIONS:

Typically, platelet transfusion may not be of therapeutic value when thrombocytopenia is due to immune destruction as with immune thrombocytopenia (ITP), thrombotic thrombocytopenic purpura (TTP), or heparin-induced thrombocytopenia (HIT). However, platelet transfusion may be indicated in these patients in the setting of clinically significant active bleeding.

Additionally, platelet transfusion is generally NOT indicated :

1. with active bleeding if this is unrelated to decreased numbers of, or abnormal functioning of platelets
2. with platelet counts greater than 100,000/uL unless there is documented or strong clinical suspicion of abnormal platelet function
3. with non-bleeding patients on anti-platelet medications
4. with platelet dysfunction that is *extrinsic* to the platelet - e.g., in the setting of uremia, hypergammaglobulinemia, or certain types of von Willebrand disease (vWD)
5. for patients with a history of hypersensitivity reaction to amotosalen or other psoralens, pathogen reduced platelets are contraindicated.

DOSAGE:

One unit of Apheresis Platelets typically raises the platelet count of a normal adult by approximately 30,000-50,000/uL as determined by a 1-hour post-transfusion platelet count. Except in the setting of massive transfusion protocol, platelet transfusions should be given as single unit.

RECOMMENDATIONS:

The majority of platelet transfusions are given *prophylactically* to help prevent bleeding in the at-risk patient. As such, it is important to know not only the patient's current platelet count, but also the factors that may affect their risk of bleeding, which may include: underlying medical conditions (see above), what medications they are on (and how long ago they may have been stopped), whether there is active bleeding, whether they have a fever, and whether an invasive procedure is anticipated. In general, prophylactic platelet transfusion is indicated in adult hospitalized patients with:

Platelet Count	In the Clinical Setting of:
$\leq 10 \times 10^9$/uL	therapy-induced hypoproliferative thrombocytopenia (e.g., chemotherapy)
$\leq 20 \times 10^9$/uL	elective central venous catheter placement or other minor invasive procedures
$\leq 50 \times 10^9$/uL	elective diagnostic lumbar puncture

$\leq 50 \times 10^9$/uL	major elective non-neuroaxial or ophthalmological procedure
$\leq 100 \times 10^9$/uL	major elective neuroaxial or ophthalmological procedure

Unfortunately, at present there are no generally accepted guidelines for platelet transfus ion with patients receiving anti-platelet therapy who present with intracranial hemorrhage (either traumatic or spontaneous).

SPECIAL CONSIDERATIONS:

1. For the platelet refractory patient:

Patients with hematologic malignancies, particularly those who require long term transfusion support, are at particular risk of platelet refractoriness, which is generally due to increased clearance of transfused platelets from the circulation due to anti-HLA or anti-platelet antigen antibodies directed against donor antigens on the platelet. This is best assessed with a one hour (10-60 minute) post-transfusion corrected count increment (CCI) that is calculated as follows:

CCI = (post-count – pre-count) × BSA / platelets transfused

For example: if a patient with a BSA of 1.40 m^2 is transfused with a single unit of Apheresis Platelets (assume a platelet dose of 4.5×10^{11}) and has an increase in platelet count at 15 post-transfusion from $2,000 \times 10^9$/uL to $29,000 \times 10^9$/uL the corrected count increment would be:

CCI = (post-count – pre-count) × BSA / platelets transfused
CCI = (29,000 - 2,000) × 1.40 / 4.5
CCI = 8,400/uL per 10^{11} per m^2

In general, a CCI of 7,500 or greater at 1-hour and 4,500 at 24-hours post-transfusion indicates an adequate response.

A CCI of 5,000 or less at 1-hour is generally associated with a poor response and indicates an immune- mediated refractory state.

Patients with platelet refractoriness may benefit from specific platelet products that help prevent immune- mediated clearance. These include HLA-matched, HLA-antigen negative, or crossmatch compatible platelets.

a) HLA antigens are divided into two groups. HLA Class I molecules are found on the surface of platelets. These antigens are viewed as second in importance to the ABO antigens. HLA antigens and antibodies become important in complications of platelet transfusion therapy such as refractoriness, febrile nonhemolytic transfusion reactions, transfusion related acute lung injure and transfusion associated GVHD.
b) White blood cells present in HLA matched platelet products can cause transfusion-associated graft-versus- host disease (ta-GVHD), so all HLA-matched platelets **must** be irradiated.
c) All patients in the Bassett Healthcare Network must have a documented platelet count unless the need for transfusion is an emergency and does not allow time for the platelet count to be completed.
d) The Blood Bank technologist will be responsible for obtaining confirmation of this test result in the electronic medical record once the initial request has been made.

ADDITIONAL NOTES:

1. Because platelets are stored at room temperature they are associated with the highest risk of bacterial contamination.
2. The anti-platelet effect of aspirin is non-reversible, but almost never requires platelet transfusion. Aspirin should be discontinued approximately one week prior to any planned invasive procedure.
3. The anti-platelet effect of Plavix and similar drugs is generally short-lived once the drug has been stopped. Since roughly 10% of circulating platelets are replaced each day, in three days there should be sufficient platelets in the circulation to allow for adequate hemostasis.
4. Drug- or alcohol-related thrombocytopenia usually resolves within 1-2 weeks after the agent is withdrawn.
5. Pathogen-reduced blood components have reduced risk for certain types of transfusion transmitted infections. This type of platelet product replaces the need to further irradiate or the need for seronegative CMV status

FRESH FROZEN PLASMA (FFP) AND PLASMA, FROZEN WITHIN 24 HOURS (PF24)

OVERVIEW:

Plasma is the aqueous, non-cellular part of blood that is derived from separation of a whole blood collection or by apheresis collection. It typically has a volume of 200-250 mL and contains numerous clinically important elements that include: albumin, coagulation factors, fibrinolytic proteins, immunoglobulins, and other proteins. Once collected, it is frozen and stored at -18 C with a shelf life of one year. In general, it is available in one of two forms:

1. Fresh Frozen Plasma (FFP) - which is frozen within 8 hours of collection and contains high levels of all coagulation factors
2. Plasma Frozen Within 24 Hours after Phlebotomy (PF24) - which is frozen within 24 of collection and contains somewhat lower levels of coagulation factors, particularly the labile factors V, VIII, and protein C.

AVAILABILITY:

All network transfusion services maintain an inventory of frozen plasma, typically PF24. Frozen plasma units must be thawed prior to transfusion. A delay of approximately 30 minutes to allow for thawing should be anticipated.

If FFP is specifically needed, Bassett Medical Center Transfusion Service should be called to determine product availability within the network.

INDICATIONS:

Broadly, plasma is indicated for the treatment or prophylaxis of bleeding associated with multiple coagulation factor deficiency, which may be either hereditary or acquired (e.g., disseminated intravascular coagulopathy, liver disease, etc.). Routine indications include:

1. Treatment of bleeding in patients with multiple coagulation factor deficiencies (e.g., secondary to liver disease, DIC, trauma, massive transfusion)
2. Treatment of bleeding in patients with known hereditary factor deficiencies for which specific factor concentrates are not available.
3. Treatment of bleeding – particularly intracranial bleeding – in patients on warfarin therapy with a prolonged PT (>1.5x mean of normal reference range)
4. Prophylaxis in the setting of invasive procedures in non-bleeding patients with acquired coagulation defects that put them at risk for significant bleeding (e.g., patients with liver disease and prolonged PT/PTT > 1.5x mean of normal reference range)
5. Prophylaxis in the setting of emergency surgery in the non-bleeding patient on warfarin with a prolonged PT (> 1.5x mean of normal reference range) when there is insufficient time to correct factor deficiency through typical measures such as holding warfarin and administration of vitamin K (oral or intravenous)
6. Prophylaxis in the setting of invasive procedures in the non-bleeding patient with a known history of hereditary factor deficiency for which specific factor concentrates are not available.

Less commonly, plasma may be indicated in the treatment of:

1. Thrombotic thrombocytopenic purpura (TTP) or other microangiopathic hemolytic anemias such as hemolytic uremic syndrome (HUS) or HELLP syndrome
2. Prophylactic or therapeutic replacement of the anticoagulant factors protein S, protein C, or antithrombin III when specific factor concentrates are not available.
3. C1 esterase inhibitor deficiency associated with life-threatening hereditary angioedema

CONTRAINDICATIONS:

Plasma is not indicated for:

1. Volume expansion, which may be corrected using crystalloid or colloid solutions
2. As a nutritional supplement or protein source
3. As a means of promoting wound healing
4. Patients with hypoglobulinemia

Additionally, plasma transfusion is relatively contraindicated in the situation in which coagulopathy can be corrected more efficiently with specific therapy, such as:

1. Vitamin K (oral or intravenous)
2. Cryoprecipitated AHF
3. Prothrombin complex concentrates (PCC's)
4. Specific factor concentrates

DOSAGE:

The amount of plasma needed for a specific patient depends on several factors, such as the patient's plasma volume and degree of coagulopathy / factor deficiency. Broadly, a dose of 10-20 ml/kg ideal body weight will increase factor concentration levels by roughly 10% to 20%. Monitoring of the patient's PT and PTT as well as clinical monitoring for evidence of bleeding may help guide therapy.

RECOMMENDATIONS:
In general, minor perturbations in PT or PTT (<1.5x mean of normal reference range) are rarely associated with clinically significant bleeding and the use of plasma transfusion in this setting is probably not indicated unless there is active, ongoing bleeding.

SPECIAL CONSIDERATIONS:
Plasma transfusion carries with it the risk of transfusion-associated circulatory overload (TACO), which may be a significant concern in certain at-risk populations, such as the elderly and those with documented cardiac dysfunction. Infusion of plasma-containing products has also been associated with the development of transfusion-associated acute lung injury (TRALI) due to the passive transfer of anti-HLA or anti-neutrophil antibodies present in the donor plasma. This risk has been partially mitigated through the use of male-only donors or plasma from female donors who have never been pregnant.

CONVALESCENT PLASMA
OVERVIEW:
Convalescent plasma has appeared to be of benefit for the treatment of certain infectious diseases, including infections from respiratory viruses. Preliminary evidence indicates that convalescent plasma may possibly be of benefit for some patients with COVID-19, leading to improvement of their clinical condition.

One of the ways people fight infectious diseases is by developing antibodies which lead to the destruction of the invading microorganisms. These antibodies are present in the liquid (plasma) portion of blood. People who have recovered from the infection can donate plasma, which can then be transfused to patients currently ill with the virus, to help eliminate the organism and allow recovery. This process has worked in previous outbreaks of respiratory disease such as influenza, and there is early data to suggest it may work for some patients with COVID-19 (infection syndrome due to SARS-CoV-2).

The FDA has issued an **emergency use authorization (EUA)** of COVID-19 convalescent plasma which authorizes the distribution of convalescent plasma in the U.S. and administration of convalescent plasma to treat suspected or laboratory-confirmed COVID-19 in hospitalized patients.

AVAILABILITY:
Bassett Medical Center maintains an inventory of Convalescent Plasma, which is stored frozen and requires thawing prior to administration. Adequate inventory is maintained at Bassett Medical Center in an effort to supply all the network hospitals with this product when needed.

INDICATIONS:
The FDA has determined that it is reasonable to consider COVID-19 convalescent plasma as a possible effective treatment in combating COVID-19 illness caused by the SARS-CoV-2 virus. Current data suggests patients receiving high-titer units of COVID-19 convalescent plasma early

in the course of the disease benefit the most in reducing the severity or decreasing the length of COVID-19 illness.
Considering that there is no adequate, approved, and available alternative treatments, the FDA has also determined that the known and potential benefits of COVID-19 convalescent plasma greatly outweigh the known and potential risks.

While pediatric patients are not specifically covered in the EUA, FDA is allowing its use for hospitalized pediatric patients to gain access to this product.

The terms of the EUA require a fact sheet distributed to each health care provider administering COVID-19 convalescent plasma, and a fact sheet distributed to each patient and patient parent/caregiver receiving convalescent plasma. Fact sheets for health care providers are available from: https://www.fda.gov/media/141478/download and fact sheets for patients and parents/caregivers are available from: https://www.fda.gov/media/141479/download. These fact sheets include dosing instructions and potential side effects of receiving convalescent plasma

Inclusion Criteria to Determine Patient Eligibility:

1. Hospitalized patients with laboratory-confirmed COVID-19.
2. Hospitalized patients with suspected COVID-19.
3. Risks and benefits must be explained to the patient and this product requires Consent for Blood/Blood Product Transfusion form to be signed.

CONTRAINDICATIONS:
Convalescent Plasma may be contraindicated in patients with a history of severe allergic reactions or anaphylaxis to plasma transfusion.

DOSAGE:

1. The volume of plasma to be transfused will be 1 – 2 units of COVID-19 Convalescent Plasma, or approximately 200 – 250 ml per unit.
2. If a second unit of convalescent plasma is transfused, the treating physician will begin the transfusion of the second unit of convalescent plasma ≤12 hours following the completion of the transfusion of the first unit of convalescent plasma.
3. Patients with impaired cardiac function and heart failure may require a smaller volume or prolonged transfusion time (must not exceed 4 hours).

CRYOPRECIPITATE

OVERVIEW:
Cryoprecipitated Antihemophilic Factor (AHF) is a mix of cold-insoluble proteins that are prepared from fresh frozen plasma. Cryo contains relatively high levels of specific coagulation factors that include:

1. Fibrinogen (≥150 mg per unit)
2. Factor VIII (≥80 IU)
3. Factor XIII
4. Fibronectin
5. von Willebrand Factor (vWF)

AVAILABILITY:

Bassett Medical Center and A.O. Fox Hospital maintain an inventory of cryoprecipitate, which is stored frozen and requires thawing prior to administration. If the label indicates "Pooled Cryoprecipitate AHF", several units of Cryoprecipitate AHF have been pooled into a single infusion bag.

INDICATIONS:

Cryoprecipitate is indicated in the prophylaxis or treatment of bleeding due to:

1. Hypofibrinogemia secondary to lack of synthesis (e.g., liver disease or inherited deficiency) or consumption or dilution (e.g., DIC, abruptio placentae, amnionic fluid embolus, massive transfusion, or intensive plasma exchange)
2. Dysfibrinogenemias (inherited or acquired, e.g., secondary to liver disease)
3. Factor XIII deficiency associated with bleeding.
4. As second-line therapy in patients with von Willebrand disease or hemophilia A when specific factor concentrates are not available.

CONTRAINDICATIONS:

In general, cryoprecipitate should not be used unless the results of laboratory studies demonstrate a specific coagulation factor defect in the appropriate patient setting. Also, the use of cryoprecipitate should be avoided when specific factor concentrates are available (e.g., recombinant Factor VIII for the treatment of patients with hemophilia A).

DOSAGE:

1. Replacement of Fibrinogen:
   The recovery of transfused fibrinogen is approximately 50% to 60%. A typical dose is one bag/unit per 7-10 kg of body weight, which will raise plasma fibrinogen levels by approximately 50-75 mg/dL

   Of note: thrombosis will alter the kinetics of fibrinogen metabolism and result in greater turnover. Ongoing monitoring using specific fibrinogen assays is recommended in this setting

2. Replacement of Factor VIII in patients with hemophilia A:
   If specific factor products are not available and time does not allow for their procurement, initial treatment of bleeding in a hemophilia A patient may include cryoprecipitate infusion. Dosing requires measurement of the patient's current Factor VIII level as well as determination of the target factor level. The dose may be calculated as:

   Number of bags of cryo = (desired *increase* in Factor VIII level in % × 40 × body weight in kg) ÷ (average units of Factor VIII per bag)

   Consultation with a hematologist is strongly recommended in this setting.

3. Replacement of Factor VIII in patients with von Willebrand disease:
   Since the concentration of von Willebrand factor in units of cryoprecipitate is generally not known an empiric dose of one bag per 10 kg of body weight is generally recommended. Laboratory monitoring is required to determine the frequency of administration.

   Consultation with a hematologist is strongly recommended in this setting.

RECOMMENDATIONS:
In general, the use of cryoprecipitate should be avoided in patients with hemophilia A or von Willebrand disease if specific factor concentrates are available.
While a serum concentration of fibrinogen of 100 mg/dL is usually considered hemostatic in the general population, a target concentration of 150 mg/dL is recommended in the setting of active bleeding. In the setting of postpartum hemorrhage, a higher target concentration may be warranted.

USE OF CMV SERONEGATIVE BLOOD PRODUCTS
OVERVIEW:
CMV-seronegative blood is selected by performing testing for antibodies to CMV.
Cytomegalovirus (CMV) may be present in cellular blood components from donors previously infected with this virus, which can persist for a lifetime despite the presence of serum antibodies. Up to 70% of donors may be CMV seropositive. CMV-seronegative blood is selected by performing testing for antibodies to CMV.

CMV testing is performed for red blood cells and apheresis platelet products. Plasma, cryoprecipitate and other plasma-derived components do not transmit CMV; therefore CMV testing is not required for these components.

INDICATIONS:
Transfusion of CMV-negative blood is indicated in CMV-seronegative recipients who are at risk for severe CMV infection. The risk of CMV transmission can be reduced by transfusing CMV-seronegative or leukocyte-reduced cellular components (red cells and platelet products) to those recipients that are CMV-seronegative. Transmission of CMV by transfusion may be of concern in:

1. Pregnant women and their fetuses, including intrauterine transfusions
2. Low-birthweight (≤1200 g) premature infants
3. Hematopoietic progenitor cell or solid organ transplant patients
4. Solid organ transplant recipients
5. Severely immunocompromised recipients

CRITERIA:

1. All patients in the Bassett Healthcare Network must have a documented CMV negative test result prior to ordering and releasing red cell or platelet products that are CMV seronegative and have a qualifying indication for use.
2. The Blood Bank technologist will be responsible for obtaining confirmation of this test result in the electronic medical record once the initial request has been made.

3. If cellular blood products are needed prior to test results being available, leukoreduced red cell and platelet products will be administered.

USE OF IRRADIATED BLOOD PRODUCTS

OVERVIEW:

Blood components such as red blood cells and apheresis platelet products contain viable lymphocytes that may be irradiated to prevent proliferation of T lymphocytes which is the immediate cause of TA-GVHD. Irradiated blood is prepared by exposing the component to a radiation source. The standard dose of gamma irradiation is 2500 cGy targeted to the central portion of the container with a minimum dose of 1500 cGy delivered to any part of the component.

INDICATIONS:

Irradiated cellular components are indicated for use in patient groups that are at risk for TA-GVHD from transfusion. At-risk groups include:

1. Fetal and neonatal recipients of intrauterine transfusions
2. Selected immunocompromised recipients
3. Recipients of cellular components known to be from a blood relative
4. Recipients who have undergone marrow or peripheral blood progenitor cell transplantation
5. Recipients of cellular components whose donor is selected for HLA compatibility.

Potential Indications:

6. Malignancies including those treated with cytotoxic agents

Usually not indicated for:

1. Patients with HIV
2. Full term infants
3. Nonimmunosupressed patients

CONTRAINDICATIONS:

Irradiation induces erythrocyte membrane damage. Irradiated red cells have been shown to have higher supernatant potassium levels than non-irradiated red cells. The expiration date of irradiated red cells is changed to 28 days after irradiation if remaining shelf life exceeds 28 days by the supplier. There are no known adverse effects following irradiation of platelets; the expiration date is unchanged.

CRITERIA:

1. All current patient Blood Bank histories will be honored unless otherwise instructed by a provider.
2. For a new patient in the Bassett Healthcare Network that meet the indications noted above a request placed by a provider for irradiated products will be honored.
3. For new patients that do not meet the indications noted above, the request must be approved by the on call pathologist prior to honoring the request.

MASSIVE TRANSFUSION PROTOCOL

In the hospital-based transfusion service setting, “massive hemorrhage” refers to potentially life-threatening bleeding in which the patient’s entire blood volume (generally defined as between 10

and 12 units of blood) is replaced within a 24 hour period. This is most commonly encountered in the setting of trauma, obstetrical/postpartum hemorrhage, ruptured aneurysm, uncontrolled gastrointestinal (GI) hemorrhage, or in conjunction with certain surgical procedures. The purpose of the Massive Transfusion Protocol (MTP) is to maximize the efficiency of communication between the clinical service and the blood bank; ensure rapid provision of blood products with a targeted ratio of red blood cell, plasma, and platelet products; and help ensure that ongoing assessment of the patient and pertinent laboratory testing guides blood product use.

Specific details of the MTP are defined in the blood bank and hospital's Policies and Procedures and/or Standard Operating Procedures. Broadly, however, the MTP includes:

1. Initial assessment of the patient and determination of the risk of massive bleeding (generally based on history and physical examination, laboratory studies, and radiographic studies)
2. A qualified healthcare Provider must explicitly activate the Massive Transfusion Protocol, which must include notification of the Blood Bank
3. Notification of the Blood Bank must include pertinent information, which includes:
    i. Patient name, date of birth, sex, and medical record number if known; if unknown, then the current temporary identifier, sex, and approximate age is given
    ii. Patient location and current treating service and Provider
    iii. Pertinent clinical information, if known – particularly as to whether the patient is currently on anticoagulation medications
4. The Blood Bank will immediately prepare red blood cells, plasma, and platelets for transfusion; the type of products will depend on whether the patient has a current valid specimen in the blood bank for ABO/Rh, antibody screen, and crossmatch testing – in the setting in which no specimen is currently available, uncrossmatched O NEG red cell units and AB plasma may be issued
5. The blood bank will continue to prepare blood products in a predefined ratio of red cells:plasma:platelets with the goal of maintaining a ready supply for pickup
6. The clinical team is responsible for ongoing assessment of the patient, obtaining appropriate laboratory testing to facilitate transfusion decision, and notify the blood bank of changes in the patient status – particularly as when the protocol may be terminated

In addition to routine blood components, consideration may be given to the use of other products such as recombinant Factor VIIa (NovoSeven) in the setting of uncontrolled and life-threatening bleeding.

Initiation of the MTP does not obviate the need for sound transfusion practices: all specimens for blood bank testing must be appropriately labeled per protocol, blood transfusion must follow all pertinent hospital policies, and patients must be closely monitored for evidence of adverse transfusion reactions.

In the setting of **Massive Obstetrical Hemorrhage**, a particular consideration is that of **fibrinogen levels**, which have been correlated with the severity of maternal hemorrhage. In general, a serum fibrinogen level of 100 mg/dL is considered hemostatic. However, in the obstetrical patient, a higher target of at least 150-200 mg/dL is often promulgated.

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