Back to the future: revitalizing the use of whole blood transfusions

Up to 20% of trauma-induced hemorrhagic deaths can be prevented when the right resuscitative and bleeding control measures are implemented in a timely manner. However, finding the right mix of blood components to meet both oxygenation and coagulopathy demands is challenging. Enter whole blood, which offers a concentrated yet balanced product that meets these needs. Increased activities in military engagements worldwide have provided opportunities to evaluate the efficacy of whole blood and have enhanced interest in this product.

The use of whole blood to manage severe bleeding is not new. More than 800,000 whole blood units were transfused during the Korean War and Vietnam Wars, with extremely low adverse reaction events (<1%) of hemolysis or other transfusion-related reactions. Current military engagements in Iraq and Afghanistan have reinforced the safety considerations and have shown the benefits of early implementation. Lessons learned include improved logistics of inventory blood management and blood administration by both the blood bank and clinical staff.

A recently published study from the University of Pittsburgh evaluated the use of type O whole blood units given to 102 civilian trauma recipients who were either non–group O or group O. The products were cold-stored at 1–6°C and tested to ensure that the anti-A and -B antibodies were of low titer (<50). Up to 4 whole blood units were transfused per patient, with monitoring of several hemolytic biochemical markers in the subsequent 2 days.

Results indicated that there was no significant evidence of hemolysis or other adverse event, whether or not the recipient was O-type matched to the donated unit. Hospital and intensive care unit length of stay and in-hospital mortality rates were similar between the two study groups. With these findings, the study provides support for the safety criteria of large volume transfusions of non-ABO–matched whole blood products, as well as the feasibility of use for the general civilian population.

When evaluating whether to offer the use of whole blood, there are several factors that should be considered. For instance,
although cold-stored whole blood units may have better hemostatic effect (as evidenced in various published studies), leukoreduction can reduce the platelet concentration in the container. Use of a platelet-sparing filter will diminish this loss.

Mark Yazer stated it best when he wrote that, since there is no recognized value that ensures a hemolytic reaction will not occur, “titering the antibodies in group O WB should be considered a hemolysis risk mitigation strategy and not a risk elimination step.” To address this concern, as well as to meet the new AABB 31st Standard for Blood Banks and Transfusion Services, recipients whose ABO group status is unknown or who are non–type O are to receive low-titer group O whole blood. Defining the threshold of what constitutes a “safe” titer and the method of testing (i.e., gel versus tube-based) are left at the discretion of the transfusion medicine service, in partnership with their clinician colleagues. Several medical institutions, for example, have elected to implement a titer of <50, whereas others such as the Mayo Clinic and the U.S. Army have decided on a titer cutoff at 200 and 256, respectively.

As the interest in the use of whole blood units increases, future studies will need to focus on how the transfusion of whole blood will decrease dependency on blood component therapy. Clinical efficacy, as well as the impact on blood donor operations that may affect recruitment strategies and donor testing processes, should also be considered.

Seheult JN, Bahr M, Anto V, et al. Safety profile of uncrossmatched, cold-stored, low-titer, group O+ whole blood in civilian trauma patients. Transfusion. 25 May 2018 [Epub ahead of print]


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**Liquid plasma reviews**

Liquid plasma is not considered a new product. As early as the 1930s, liquid plasma has been manufactured as a whole blood–derived component that is never frozen, but rather is stored at 1–6°C for up to 5 days after the expiration date of the donated whole blood product, as stated in the Circular of Information (COI) for the Use of Human Blood and Blood Components (the shelf life of a whole blood CPD unit is 21 days; shelf life for the associated liquid plasma unit is 26 days).

Because of a shift in transfusion practice for immediate administration of plasma and red cells to a ratio of 1:1 in active massive bleeding patients, demand for liquid plasma has increased. This is particularly true because liquid plasma does not require time to thaw and is thus more quickly available than standard fresh frozen plasma. In addition, since fresh frozen plasma units must be used within 24 hours or transfused within 5 days once thawed, liquid plasma eases stress in inventory management.

A critical component for consideration in trauma is coagulopathy that is characterized by decreased levels of such critical complement factors such as II, V, VII, IX, and X,
which can be replaced with use of plasma. Concerns about the potential loss of these factors with increased storage time, especially as it relates to liquid plasma products and how liquid plasma can support clotting potential, is reviewed in two articles (Gosselin et al., 2013; Backholer et al., 2017).

The article by Gosselin et al. (2013) details the effect that storage time (of up to 30 days) has on coagulation factor levels in liquid plasma. The researchers’ findings show that although there is a significant decrease in factor V, factor VII, factor VIII, endogenous thrombin potential (ETP), and von Willebrand factor (vWF), protein S activity on day 15 is comparable to that on day 1. Beyond 15 days, in vitro studies looking at thrombin generation (ETP) showed significantly decreased clotting potential to approximately half normal activity levels. The study also confirmed that factor levels varied by blood group (i.e., group O to non–group O), indicating that samples from group O donors had lower factor VIII and vWF. However, because liquid plasma is indicated in trauma where the blood type of the patient is unknown during the first hours of surgery, it is generally supplied as group A or AB.

A more recent article by Backholer et al. (2017) also supports the use of liquid plasma with up to 14 days’ shelf life. Two ABO-matched plasma units were pooled and then split to make 1 liquid plasma and 1 frozen unit. Both study arms were compared, evaluating clotting factor levels at different storage end points. Results from thawed plasma at 5 days old were compared to liquid plasma units with up to 28 days’ shelf life. The results were similar to results in the previously mentioned article (Gosselin et al., 2013), with no differences noted in factor levels until day 11, when factors II, V, and VII and protein S activity were notably decreased in liquid plasma units, but not sufficiently to be of clinical concern to hemostatic potential.

A matter of interest is that the intrinsic complement pathway was activated with liquid plasma older than 14 days, potentially inducing a thrombotic event in susceptible patients. For this reason, the authors suggested liquid plasma should be limited to specific patient populations (e.g., trauma) as defined by the hospital’s transfusion service medical director, limiting the liquid plasma to <15 days of storage. Further studies to evaluate the effectiveness of liquid plasma on clinical outcomes are needed to more precisely define storage shelf life.

Blood resuscitation protocols have changed greatly in the last few decades, with crystalloid-heavy algorithms giving way to blood component therapy and, once again, transfusion of whole blood. The needs arising from conflicts and wars continue to influence and inform the manufacturing and delivery of blood products.

Plasma is a critical blood component in the restoration of coagulation factors and oncotic pressure during hemorrhage. Patients also need red cells and platelets; however, on the battlefield, wounded soldiers are often stabilized with plasma alone until being transported to a medical facility.

Lyophilized plasma saved many lives during World War II. Recently, renewed interest in the convenience and portability of freeze-dried plasma (FDP) has led to the development of a safer lyophilized plasma product. The referenced report
by Shlaifer et al. (2017) discusses LyoPlas, which is issued by the German Red Cross. The product is manufactured from AB donors who are initially screened for infectious diseases including, among others, HIV, HBV, HCV, and parvovirus B19. The plasma is processed and quarantined for 4 months; at the end of 4 months, the donor is rescreened. If the test results are nonreactive the second time, the FDP product is released for use. The freeze-drying process preserves clotting factors at acceptable levels, including labile FVIII. Easily reconstituted with 200 mL sterile water into a hyperoncotic fluid (213 mL total), FDP has a long shelf life and may be stored for 15 months at room temperature. The manufacturer reports a very low incidence of adverse reactions (0.023%).

The Israeli Defense Forces (IDF) have used LyoPlas since 2013 in point of injury (POI) and prehospital settings. The authors of the article designed a retrospective case-series cohort study to examine the feasibility of FDP use in the treatment and outcomes of 109 casualties (in this article, the use of the word “casualties” refers to injuries not deaths) who received FDP in the prehospital/POI setting between January 2013 and June 2016. The in-hospital cohort consisted of patients treated at Israeli level I trauma centers.

The prehospital cohort was 109 subjects; 105 were male and 4 were female. The majority were between 18 and 35 years of age. Penetrating and blunt injury were the most common types of injury. In the field, if the IDF corps member encountered penetrating transitional zone or trunk injury, 1 gram of tranexamic acid (TXA) was given intravenously. Compressible bleeds were also addressed at that time. Evacuation efforts were not delayed by the resuscitative efforts. The in-hospital cohort consisted of 97 subjects, and the injury characteristics were heterogeneous to the prehospital cohort.

In the remote damage control resuscitation protocol designed by the IDF, severe hemorrhagic shock is defined as a heart rate of >130 bpm or absent radial pulse, or a systolic blood pressure <90 mmHg. Injured soldiers meeting the criteria of hemorrhagic shock were initially resuscitated with 1 unit of reconstituted FDP. If FDP was not available, 500 mL Ringer’s lactate (Hartmann’s solution) was given. The patient was reassessed, and if the criteria for profound shock were still met, the second round of resuscitation fluids consisted of an additional unit of FDP, or Ringer’s lactate solution, as above; but if red cells were available, they were given in a 1:1 ratio with FDP. If the person remained in hemorrhagic shock, additional fluids were given as during the second round of resuscitation. In the prehospital cohort, only nine patients received red cells as part of their resuscitation protocol. If the patient recovered before arrival, a slow drip of Ringer’s lactate was given.

In the prehospital cohort, most patients required additional lifesaving medical interventions including intubation, chest decompression, and surgery (84% of patients). Of the 109 patients, 80 received TXA. Those who received Ringer’s lactate received 841 ± 505 mL. The majority (n = 91) of patients received 1 unit FDP, 14 received 2 units FDP, and 5 received 3 units FDP. In five cases, access or flow difficulties hindered FDP infusion. One patient experienced a reaction (chills) that was initially attributed to the FDP product, but was later determined to be septic. Some injury data were missing in about one-third of the prehospital battlefield cohort. In-hospital mortality for this cohort was 12%.

This study showed that FDP could be used successfully in POI/battlefield and prehospital settings to stabilize patients. The authors demonstrated that the safety profile was acceptable. Additional studies are needed to further elucidate the effectiveness of FDP in the prehospital setting. Because of the myriad differences between POI conditions and urban trauma patients, these findings may not be applicable to non-battlefield settings.

“Editorial note”: On 9 July 2018, the U.S. Food and Drug Administration (FDA) officially granted emergency use authorization to the U.S. Department of Defense for use of pathogen-reduced leukocyte-depleted freeze-dried plasma for use during hemorrhage or coagulopathy during emergencies involving agents of military combat. More information is available on the FDA’s website, fda.gov.


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In healthy individuals, there is an adequate number of circulating RBCs, as measured by hemoglobin (Hb) or hematocrit (HCT), to meet tissue demands. In situations where there could be acute blood loss (e.g., in cardiac surgery), associated trauma results in anemia, which could impair tissue oxygenation. Patients with acute and chronic cardiovascular disease are more susceptible to anemia because of the unique physiology of the myocardium, characterized by high oxygen extraction.

Despite several reported studies, significant uncertainty remains regarding appropriate transfusion triggers for patients with acute myocardial infarction and in those undergoing cardiac surgeries. RBC transfusions may be associated with relatively uncommon but clinically relevant adverse effects and a waste of expensive resources if inappropriately used.

This paper describes the results of a meta-analysis comparing outcomes for patients maintained on a low (restrictive) hemoglobin threshold and those with a higher (liberal) one. Carson et al. (2018) reviewed the literature and identified 37 studies that met their inclusion criteria for meta-analysis. The trials enrolled a total of 19,049 patients. This total included 8,598 patients in seven cardiac surgery trials, 155 patients in myocardial infarction trials, 99 patients in one vascular surgery trial, and other patients in orthopedic surgery, critical care, acute blood loss trials. The primary outcome was 30-day mortality.

Although transfusion strategies varied, most used an Hb level of 7.0–8.0 g/dL as a restrictive transfusion threshold and 9.0–10.0 g/dL as a liberal transfusion threshold. In all trials combined, the number of patients receiving at least one red cell transfusion in the restrictive transfusion strategy was 50%, compared to 80.6% in the liberal transfusion strategy.

In four trials (n = 7,441) conducted in patients undergoing cardiac surgery, the risk ratio for 30-day mortality for the restrictive group compared to a liberal transfusion strategy was 0.99, indicating no significant difference. On average, restrictive transfusion strategy decreased exposure to red cells by >30%, but had no adverse effects on clinically important outcomes such as survival and complications. However, the TiTRe2 study (Murphy et al., 2015) found that the liberal transfusion strategy might reduce 90-day mortality when compared to the restrictive transfusion strategy.

A large trial (Mazer et al., Epub ahead of print) that studied 6-month outcomes after restrictive or liberal transfusion for cardiac surgery was recently published. This study was conducted at 74 sites in 19 countries and randomly assigned 5,243 adults undergoing cardiac surgery to a restrictive red cell transfusion strategy (transfusion at Hb <7.5 g/dL intraoperatively or postoperatively) or a liberal red cell transfusion strategy (Hb <9.5 g/dL intra- or postoperatively in the intensive care unit [ICU] or <8.5 g/dL for patients in the non-ICU ward).

Primary composite outcome was death from any cause, myocardial infarction, stroke, or new-onset renal failure, with dialysis occurring 6 months after initial surgery. At 6 months after surgery, primary composite outcome had occurred in 402 of 2,317 patients (17.4%) in the restrictive threshold group and in 402 of 2,347 patients (17.1%) in the liberal threshold group (P = 0.006 for noninferiority). Mortality was 6.2% in the restrictive group and 6.4% in the liberal group.

In summary, according to the meta-analysis conducted by Carson et al., a restrictive transfusion strategy of Hb 7–8 g/dL was safe in patients undergoing cardiac surgery and decreased red cell use by 24%. According to a recent large-scale investigation in patients undergoing cardiac study who were at moderate to high risk for death, a restrictive red cell transfusion strategy at Hb <7.5 g/dL was noninferior to liberal red cell transfusion at Hb <9.5 g/dL. To definitively draw conclusions on the best thresholds to use more research is needed.


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Where have all the O-negs gone? An international survey of 31 health care centers on the use and conservation of O– red blood cells

The universal donor type for red blood cells (RBC) (group O RhD– or O–) is relatively scarce (the frequency of O– blood in the population hovers around 8%), but hospital demand for this blood type remains high. Surprisingly, the recent decline in RBC transfusions attributed to patient blood management has made supplying O– blood even more challenging, since the demand did not drop with the overall decrease in RBC transfusions. As a result, blood centers are now distributing a higher percentage of units as O– than in the past. And although shortages of O– blood are not new to blood-bankers, preserving this precious resource for people who may need it most (e.g., neonates, stem cell transplant recipients, and especially O– young women to prevent occurrence of hemolytic disease of the newborn) will likely become ever more important as supplies become increasingly strained. Consequently, some transfusion services conserve their O– supply for such patients by switching men and postmenopausal women who are group O– or ABO group unknown, to O+ blood in emergencies and during shortages. This international survey, conducted by Drs. Dunbar, Yazer, and the BEST Collaborative, examines the O– transfusion policies and practices of 31 different institutions (26 individual hospitals and 5 systems) to determine if O– use could be improved by applying this practice of switching to O+ RBCs more often.

Each participating transfusion service retrospectively analyzed their 2016 calendar year transfusions for how often O– patients received O+ RBC transfusions. Each service also analyzed how D switching rules based on the recipient’s age, sex, and hospital location would have reduced O– use if the guidelines had been followed more routinely. All patients had to be more than 1 year old with documentation of gender and ABO/Rh types. Twenty-eight of the sites also indicated the department ordering the blood.

Of the 26 participating single hospitals, 16 (61.5%) had a defined policy or procedure for emergency release of O+ RBCs. Fourteen centers issued O+ RBCs to all males who required urgent transfusion, regardless of age, while two hospitals required the patient be over 16 and 18 years of age, respectively. For emergency release of O+ RBCs in females, 12 hospitals used an age cutoff of 50 years, 3 used an age cutoff of 55 years, one supplied D+ RBCs to all females regardless of age, and one large, multicenter, national system used an age cutoff of 45 years.

Ultimately, 475,830 RBC transfusions were analyzed. A total of 51% of the data (243,581 RBC units) came from North American institutions, 3% came from hospitals in South America, and the remaining units were almost evenly divided among Europe, Oceania, and Israel (18%, 15%, and 13%, respectively). Nine percent (42,960 of the 475,830) were O– units administered to either O– patients (24,228 of 42,960, or 56.4%) or non-O– recipients (18,732 or 43.6%) (Fig. 1). A total of 27,565 units were given to O– patients: 3,337 were O+ units, and again 24,228 units were O–.

The authors determined these institutions could have reduced their O– use by 44.5% if O+ units had been given to all O– patients who were at least 50 years old, or by 9.9% if all O– patients over 80 years old had been switched. In the intensive care unit, overall use of O– RBCs would have decreased by 8.7% by switching all O– recipients over the age of 50 years.

The data provided by the 26 single hospitals revealed that medical centers willing to take short-dated O– units (i.e., close to expiration) from other hospitals to avoid wastage have a higher rate of O– use than centers that did not accept them. However, there were no significant differences among the individual centers for any of the following:
1. The fraction of transfused units that were O– or
2. The fraction of O+ RBCs provided to O– patients based on these hospital-specific factors:
   a. Total number of RBC units transfused annually (>10,000 vs. <10,000 per year)
   b. Whether the hospital:
      i. Had a trauma service
      ii. Performed allogeneic stem cell transplants
      iii. Treated neonates
      iv. Saw high-risk obstetric patients

The authors concluded the availability of O– RBCs for women of child-bearing age could have been improved if substitution of O+ units for O RhD– had been done more routinely using the recipient’s age, gender, and hospital location to guide the decision.

The study’s limitations included the following:

1. Most study participants were from countries with large Caucasian populations; thus, the data presented may not be applicable to geographic areas with a different prevalence of the D– blood type.
2. Of the 26 individual hospitals, 24 (92%) were academic centers, so their practices may not be representative of practices occurring in community-based hospitals.
3. Individual hospital practices could not be determined for the five multicenter systems.
4. Since the data were deidentified and aggregated from 31 institutions, the number of transfusions per patient and their disease states could not be ascertained.
5. The survey did not inquire about the rate of anti-D formation or the incidence of hemolysis and therefore could not assess the potential immunologic effects of routinely giving O+ RBCs to O– patients. However, the authors acknowledge that recent literature has a frequency of alloimmunization that is much lower than previously thought (at around 20–25%). Accordingly, hemolytic transfusion reactions from an anti-D are also extremely rare, and the investigators were only able to find two case reports of delayed hemolysis.

This survey provided a 30,000-foot view of current transfusion practices around preserving O– RBCs and, more specifically, the survey explored how often age and gender of O– patients are considered when trying to save these increasingly precious units. The study found that at least 50% of the time (21,508 of 42,960) these units were given to O– females over the age of 50 years or to men. Also, clinical information on the over 18,000 O– units given to patients of other ABO/Rh groups was not surveyed. In the end, the study does not provide the level of individual patient detail to say with absolute confidence these 40,000+ O– units could have been easily saved for women of childbearing age, but it strongly suggests there is at least significant room for improvement.

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Recently, there has been much thought and effort put into exploring whether using mixed blood products, such as whole blood, might be better than using blood components in certain clinical situations, such as massive trauma. A newly published study contributes to work demonstrating how storing platelets mainly in a balanced salt solution, also known as platelet additive solution (PAS), might be advantageous and result in fewer complications for the general patient population.

A recent study by Weisberg et al. (2018) confirmed that platelet units collected in 65% PAS with 35% plasma have proportionally less plasma proteins, lessening the potential for transfusion-related reactions. In addition to ABO antibodies, which can cause hemolysis, these substances include plasma proteins (which may act as allergens, cytokines, or other bioactive small molecules, inducing fever) and HLA antibodies that are associated with transfusion-related acute lung injury (TRALI). The results support findings from a 2014 article by Cohn et al. suggesting that dilution by PAS of the wide array of substances found in plasma might explain the decreased transfusion reactions, such as the more common allergic and febrile non-hemolytic type. The findings by Cohn et al. have now been further supported in a larger study performed in the Netherlands by van Hout et al. (2018).

To understand how PAS platelets might affect reaction rates when compared to plasma platelets, Weisberg et al. evaluated the quantity of anti-HLA antibodies, the presumed trigger for TRALI reactions, as well as ABO titer reduction rates by the anticipated dilution in PAS. The results confirmed that the anti-A and -B titers were reduced; in contrast, a more profound difference was noted in quality rather than quantity of anti-HLA antibodies. In other words, there was a drastic decrease in identifying various different anti-HLA antibodies with the PAS collected versus the plasma-based donor platelets. As the authors noted, this correlates strongly with the risk of developing TRALI, since the number of donor antibodies to specific recipient HLA antigens exist in the transfused product.

Unfortunately, because of the small sample size, it was not possible to confidently show quantitative differences despite their observation, and for this reason, the authors concluded that more work was needed to bolster their new data, suggesting that PAS platelets might then be recognized as an additional measure to mitigate TRALI. Overall, these articles offer support for PAS platelets as an alternative option that can help to reduce transfusion reactions, perhaps to some degree even in TRALI mitigation.


Weisberg SP, Shaz BH, Tumer G, Silliman CC, Kelher MR, Cohn CS. PAS-C platelets contain less plasma protein, lower anti-A and anti-B titers, and decreased HLA antibody specificities compared to plasma platelets. Transfusion 2018;58:891–895.

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Zika virus: an ongoing threat

In early 2015, reports began to emerge from Brazil about the Zika virus (ZIKV) causing fetal defects, including microcephaly and encephalitis. Soon, news about ZIKV seemed to be everywhere: it spread across the globe so rapidly that the World Health Organization (WHO) declared a Public Health Emergency of International Concern (PHEIC).

Spread by mosquitoes (arthropod vector), ZIKV is an arbovirus of the flavivirus genus. The species Aedes aegypti and Aedes albopictus are known to harbor ZIKV. Up to 80% of people infected by ZIKV never exhibit symptoms, but individuals who become ill can be severely affected. The virus was linked with myelitis and with increasing the risk for Guillain-Barre syndrome. Surveillance, studies, and testing were inadequate. There was evidence that the virus was transmitted sexually. Reports of transmission by blood transfusion concerned the medical and blood-banking communities.

More than 5,300 cases of travel-related ZIKV and 200 cases of locally acquired ZIKV have been identified in the continental United States. To date, only four cases of transfusion-transmitted ZIKV have been confirmed in Brazil; none have been reported in the United States.

The U.S. Food and Drug Administration (FDA) determined that ZIKV was a threat to blood safety and, in February 2016, released recommendations to reduce the risk of transmission to patients. Less than 1 month later, the American Red Cross (ARC) modified their donor history questionnaire to assess ZIKV risk, including a deferral plan. By June 2016, the ARC implemented ZIKV screening of donor blood with an FDA-approved investigational new drug protocol. Testing was done in Puerto Rico using the Procleix Zika Virus Assay. This test screens donated blood for the presence of ZIKV RNA using transcription-mediated amplification (TMA) technology with a 95% limit of detection of 3.9 copies per milliliter. Reactive test samples were retested with TMA, tested using through red cell TMA, and by IgM serology of the donor. It is reported in the literature that ZIKV may remain in a red cell for as long as 101 days. In the ARC studies, ZIKV was found in red cells at 154 days (whereas in the same donor’s plasma, ZIKV was detectable only until day 66).

Between June 2016 and September 2017, a total of 4,325,889 donations were screened by the ARC, of which 3,932,176 were tested individually and 393,713 were tested in mini-pools (MPs). Initially, donors from five U.S. southeastern states (Alabama, Florida, Georgia, Mississippi, and South Carolina) were tested for ZIKV using MPs; after the initial positive MP, testing was changed to individual (ID). Following the FDA August 2016 guidance, testing was gradually expanded to include all U.S. states and territories, and by early December 2016, all ARC donors were being tested for ZIKV using ID-TMA.

In summary, 161 donors were initially reactive, but 9 donors were confirmed to be ZIKV-positive (1 of the 9 was positive because of an experimental ZIKV vaccine). The final analysis revealed a very large cost-per-positive test of $5.3 million (using individual nucleic acid testing). Such expenses may be prohibitive in long-term situations, especially as pandemics such as this one wane. Results such as these may prompt the adoption of technology that can inactivate, or eliminate, a wide range of pathogens before transfusion, at a much lower cost.

The authors of these reports bring up several key points, namely that the FDA continues to recommend screening for ZIKV in the United States and its territories using ID or MP nucleic acid testing, switching to ID nucleic acid testing (ID-NAT) during certain threshold events. Alternately, the FDA permits pathogen reduction technology for platelet and plasma products (July 2018 guidance). It was noted that although responses to donor history questions may be supplemented to assess a donor’s risk to infection, most people with ZIKV were asymptomatic. This hardy virus is known to survive storage and processing and still be transmissible by transfusion.

Although the WHO declared the end of the PHEIC in November 2016, it was nearly 1 year later that the Centers for Disease Control and Prevention deactivated its response, and research continues. The epidemiology of ZIKV and other agents warrants additional study. In conclusion, new and
Platelets provide potentially life-saving benefits to cancer and other patients. However, these blood components are fragile and are subject to platelet storage lesions (PSLs), a condition resulting from changes to platelet function and efficacy that occurs during storage. A recent publication (Ng et al., 2018) summarizes recent basic science about platelet physiology when they are stored.

PSL is defined as “a series of biochemical, structural, and functional changes that occur from blood collection to transfusion.” The referenced publication breaks down PSL biology into eight mechanisms, exploring the implications of PSLs for clinical practice and highlighting five areas of active research in PSLs. An important strength of this review is that it is an appropriate resource for the international transfusion community, as platelet preparation and storage methods from around the world are explained and compared.

Because platelets that have been refrigerated are rapidly cleared, platelet concentrates (PCs), whether derived from platelet-rich plasma, buffy coats, or apheresis, are commonly stored at room temperature. Primary biochemical consequences of 5–7 days of storage with agitation are associated with increasing anaerobic respiration by glycolysis as the tricarboxylic acid cycle becomes less effective in ATP generation. Surface receptors are modified as degranulation and activation increase. The resulting platelet lysis creates platelet microparticles that can activate thrombin to increase aggregation and promote the coagulation pathway. This step may partly explain the maintained hemostatic effects of stored PCs despite decreased post-transfusion platelet survival as storage time increases.

In clinical practice, the corrected count increment (CCI) is a common measure of post-storage and post-transfusion platelet survival and has become central to the interpretation of platelet transfusion efficacy. However, this metric gives no indication of platelet function. It remains a challenge to determine whether the biochemical, immunologic, and vasoactive effects that define the PSL is an important factor in clinical outcomes. For example, although some studies have found longer transfusion intervals with fresher platelets, others have found no relationship in similar patient populations. The article by Ng et al. reviews the obstacles facing clinical research on PSL research on patient outcomes, which include laboratory correlates with patient bleeding, small study cohorts, observational protocols, subset analyses, and the biases these limitations introduce.

The section “PSL Research: A Moving Topic” provides an overview of a possible future. As the transfusion medicine community battles bacterial contamination in platelet products, the appeal of cryopreserved or cold-stored PCs increases. There is resurgent interest in clinical reports from decades ago that supports changing the platelet transfusion paradigm from a “one product fits all” indication to perhaps using a room temperature–stored PC for prophylactic transfusion but a cold temperature–stored PC for active bleeding. This insightful review reminds us that advances in the biochemistry, immunology, and basic biology of platelets force us to question the status quo of platelet product preparation and storage to better understand the clinical consequences of the PSL.
Whole Blood for Trauma

When treating a patient experiencing massive hemorrhage, every moment is precious. Recently there has been a resurgence in the use of and interest in fresh whole blood for these vulnerable patients. Whole blood provided by Red Cross contains all the blood constituents a trauma victim requires: red cells, platelets and plasma. Use of this ready-to-go product can save valuable time when compared to use of component therapy.

This issue of PLUS leads off with an article on whole blood. For more information and other citations, please contact your Red Cross representative.

Publications Corner

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