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PLATELETS AND LEUKOCYTES IN BLOOD COMPONENTS

Preparation and Storage Effects

The majority of platelets and white blood cells present in freshly collected units of anticoagulated whole blood are transferred to the units of packed red blood cells during component processing. These cells have undergone some degree of centrifugation shock which causes release of intracellular enzymes and may produce transient or permanent cell damage to a portion of the cell population. Damaged cells, being less viable and efficacious, are rapidly cleared from the circulation by the reticuloendothelial system (RES).

In addition to the small but measurable preparative damage to platelets and white cells, a "storage lesion" also occurs. For example, after 5 days of storage, transfused platelets have an average reduction in circulatory recovery and survival of 25-30%. Platelets and leukocytes in stored blood or packed cells become more adhesive with storage and so are more easily trapped and removed by blood filters during transfusion.

Platelet remnants in Plasma Components

Significant number of platelets also remain in units of freshly prepared plasma and consequently are present as organelles and membrane microparticles in fresh-frozen plasma and its derivative products, cryoprecipitate. The platelet membrane microparticles may have therapeutic benefit, as these products correct the bleeding time of some patients with platelet defects such as storage pool disease and uremia. The platelet membrane microparticle count of fresh-frozen plasma is about 25 times that of fresh, while the number in cryoprecipitate is increased another 10-fold as a result of the concentration/volume reduction of this product. Cryoprecipitate has about 250 times the microparticle count of the original starting plasma.

Blood Transfusion Effects on Recipient Platelet Count

Recent studies in humans have shown that transfusion of red blood cells through standard 170-micron blood filters can produce a significant decrease in the circulating platelet count of recipient patients. Their platelet counts fall because of increased splenic sequestration. The effect varies with the age of the unit of packed red cells (from as much as 45% for blood less than 10 days old to only 13.5% for blood stored more than 20 days). This difference reflects the increased adhesiveness of older platelets and leukocytes and their more efficient removal along with other particulate debris during filtration. By contrast, the microaggregated cellular debris in younger units of red cells more readily passes through the blood filter and tends to adhere to the patient's circulating platelets which are then removed by the splenic RES. Studies have yet to confirm whether reducing the filter size to 40 microns would obviate much of this drop in platelet count which could be clinically significant in treating anemic thrombocytopenic patients. One could extrapolate from this information that thrombocytopenic patients needing red blood cell transfusions should receive older units of stored red cells or perhaps freshly collected units of whole blood to reduce the microaggregate content entering the patient's circulation.

Alloimmunization

Repeated transfusion of platelet and red blood cell components frequently induces alloimmunization and refractoriness. This sensitization has been attributed to the contaminating white blood cells present in blood products. Leukocyte immunization is responsible for many adverse clinical effects such as nonhemolytic febrile transfusion reactions and poor therapeutic response to platelet transfusions.

Several approaches have been used to minimize this side effect in multiply transfused patients. These include: selective filtration to remove the leukocytes from whole blood or platelet-rich plasma, ultraviolet U-V) irradiation, and platelet cross-matching.

Platelet cross-matching. Despite use of HLA-matched platelet donors with its attendant increased effort and cost, as least 30 % of alloimmunized human patients fail to benefit. Random donor platelet matching is offered as an alternative although family members appear to provide the best match. Platelet cross-matching for animals is only performed in research settings.

U-V Irradiation. Research studies showed that 92 % of dogs given U-V irradiated platelets did not become platelet –refractory after 8 weekly random canine transfusions. By contrast 86 % of those receiving non-irradiated platelets became refractory. These results suggest that U-V treatment of platelet products would be beneficial for canine patients in need of repeated transfusional support. Ready access to a U-V source and the additional cost may be problematic.

Cyclosporine A. Studies in dogs have also shown that cyclosporine A may reverse platelet alloimmunization. The dose of cyclosporine was 15-20 mg/kg/day given continuously. The dogs were given 8 weekly transfusions of random donor platelets. Improvement of post-transfusional platelet recovery occurred by the 2nd or 3rd week of treatment.

Preparation of Leukocyte-Poor Platelet Products

The risk for alloimmunization is significantly reduced if platelet-rich plasma is passed through a specific trapping filter. Several types of filters made of coated and noncoated polyester fibers, cellulose acetate and cotton wool are available. The initial unit of whole blood can be filtered to remove leukocytes beforehand or filtration can be applied to the red blood cell and platelet components afterwards. The drawback for veterinary medicine is the relatively large volume needed to charge these filters and their cost (about $75 per unit).

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