Hemolysis during leukocyte-reduction filtration of stored red blood cells

RR Gammon, SA Strayer, NL Avery, and PD Mintz

Hemolysis has been reported in red blood cells (RBCs) that have undergone leukocyte-reduction filtration. This study investigated whether the age of RBCs or the filter type affected hemolysis. One hundred eighty units of RBCs (adenine-saline added) were leukocyte-reduced by filtration. At each of the 6 weeks of shelf life, 10 units were filtered with the "BPF4" filter, 10 units with the "Purecell RCQ" filter, and 10 units with the "Sepacell" filter. Filtration was performed with strict adherence to the manufacturers' directions. Pre- and post-filtration samples were assayed for plasma hemoglobin by measuring the plasma absorbances at 578 nm and 562 nm. The increase of plasma hemoglobin concentration following filtration was significantly greater (p < 0.05) in older units, compared to fresher units, when the Sepacell and BPF4 filters were used. For example, the increase of plasma hemoglobin at week 6 (83.47 mg/dl: Sepacell, 128.93 mg/dl BPF4) was significantly greater than at week 1 (7.07 mg/dl Sepacell, 4.77 mg/dl BPF4) (Sepacell: p=0.008; BPF4: p=0.006). For units stored 1, 2, 4, 5, or 6 weeks, the increase of plasma hemoglobin concentration post-filtration was significantly greater with the BPF4 filter, compared to the Purecell RCQ filter (p <0.045); for units stored 5 weeks, the increase in plasma hemoglobin concentration post-filtration was significantly greater with the BPF4 filter compared to the Sepacell filter (p = 0.009). Mean filtration times were significantly longer in older units compared to fresh units. This study shows that increased storage duration of RBCs (adenine-saline added) is attended by greater hemolysis during leukocyte-reduction filtration and by prolongation of the filtration time. In addition, the amount of hemolysis may be influenced by the type of filter.
Abstract

**Introduction:** Apart from the visual assessment, measurement of plasma hemoglobin in the supernatant from red cell units provides an objective measure of the extent of hemolysis during storage. **Study Design and Methods:** Packed red cells (N=50), 25 units each in triple (CPD-A1 and SAGM) and quadruple (CPD-A1 and ADSOL) blood bags were evaluated for plasma hemoglobin by the tetramethylbenzidiene (TMB) method on day 1, 7, 14, 21 and 28 of collection. The hemoglobin, hematocrit, MCV, LDH and potassium levels were also noted. Whole blood units (N=25) were used as controls. **Results:** Hemolysis increased in all the stored red cell units. Plasma hemoglobin increased significantly in the first week of storage. The hemolysis, LDH and potassium levels were found to be significantly higher in the red cell units harvested from the triple blood bags. However, on day 28 of storage, free hemoglobin in all the red cell units was much below the 0.8% hemolysis. **Conclusion:** Hemolysis of the red cells increases due to processing and during storage and is maximum during the first week. Adequate process control and proper storage facilities should be ensured to minimize the hemolysis of red cells during processing and storage.