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Hemolysis during component preparation: An inadvertent cause

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We introduced a new type of blood bags from two different manufacturers at our center with diversion pouch and sampling device. Stripping of tube segments was also introduced to have anticoagulated blood in satellite tube. During component preparation, we observed 11 blood bags were showing pinkish to red colored plasma immediately after first centrifugation which was suggestive of hemolysis [Figure 1]. These bags were collected during outdoor blood donation camps and in-house collection on different occasions over 2-month period out of total collection of approximately 10,000.

Plasma hemoglobin in the bags was measured using Plasma/Low Hb System, HemoCue®, Sweden, and percentage hemolysis was calculated using following formula:^[1-3]

$$\text{Percent hemolysis (\%)} = \frac{(100 - \text{hematocrit}) \times \text{free hemoglobin in plasma (g/L)}}{\text{Bag hemoglobin (g/L)}}$$

Plasma hemoglobin in these bags ranged from 2.8 to 4.4 g/L and percent hemolysis ranged from 1.2% to 2.18%. As per quality control criteria, hemolysis at the end of

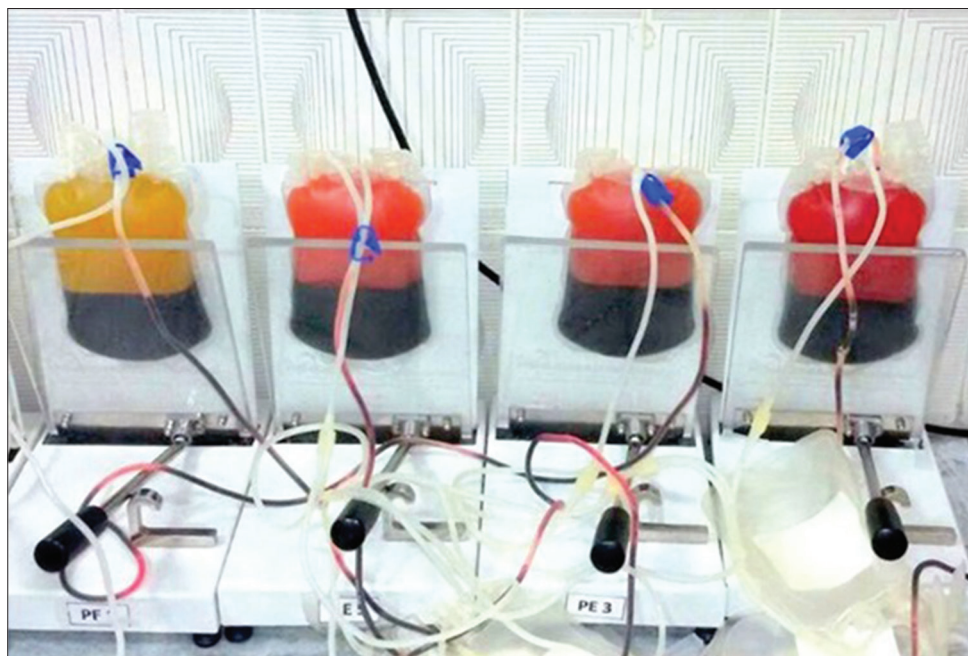


Figure 1: Normal supernatant plasma in first bag and pinkish to red discoloration of plasma due to hemolysis in next three bags after first centrifugation for component preparation

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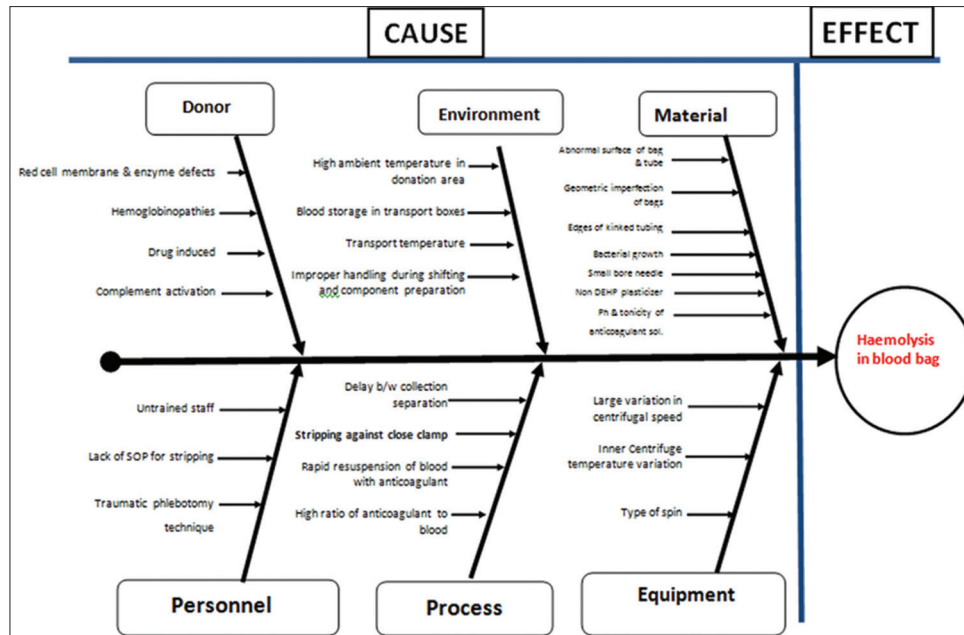


Figure 2: Fishbone diagram for causes of hemolysis during component preparation

storage should be <1% in the United States or <0.8% in the European Union.^[4] All these bags had percentage hemolysis of >1% on day of collection. We looked into the causes of hemolysis starting from blood collection to component preparation as shown in fishbone diagram [Figure 2]. Blood bags used were of standard specifications and ISO 3826 certified. As hemolysis was found in three bags in a single day, so donor-related factors could be ruled out. The G6PD levels were normal in all these bags. There were no phlebotomy-related problems (i.e., traumatic phlebotomy or hematoma) and collection time was within limits. Anticoagulant to blood ratio was maintained as there was no under collection. Bacterial contamination was ruled out as the culture from these bags was sterile. Component preparation was done using regularly calibrated refrigerated centrifuge. The most probable reason for hemolysis was narrowed down to shear stress due to turbulent flow caused by stripping across partially opened or closed Robert clamp as described earlier in literature.^[1] Results were reproduced on quality control bags as deliberate stripping tube against closed clamp even once produces a similar amount of hemolysis in the bag. These packed red blood cell (PRBC) bags were used for this experiment just before discarding after routine quality control. Another clue to this cause, during investigation, it was found that in some of the bags, stripping was done by untrained helper staff during rush of donors in outdoor blood donation camps.

To take corrective and preventive action, stripping is temporarily stopped in blood donation camps but is continued in in-house blood collection where all the staff nurses are under retraining by rotation. During 3-month follow-up, it was noted that out of 12,000 blood bags

collected at camps, none of the bags showed hemolysis whereas similar hemolysis was observed in 1 out of 3000 bags collected during in-house collection where staff is under training.

Conclusion

Hemolysis due to turbulent shear stress on RBCs can occur due to kinks in the tubes, partial opening of inline seal or partially opened entry ports at the time of stripping.^[1,3] This incident emphasizes that before the introduction of any new type of blood bags or new technique, proper training should be given to all staff members and compliance to standard operating procedure should be observed regularly.

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Conflicts of interest

There are no conflicts of interest.

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