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## CDPA-1 Stored Blood Induced Effect on some Haematological Parameters

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Running head: HAEMATOLOGICAL CHANGES IN CPDA-1 STORED BLOOD

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### Abstract

**Background:** Most blood collection bags contain 63 mL CPDA anticoagulant which is sufficient to anticoagulant and ensures the viability of blood cells in 450 mL $\pm$ 10% blood for up to 28–35 days when the blood is stored at 2–8°C. Prolonged storage of blood leads to alteration in cells hematologically which may lose viability with time. **Aim:** The study was conducted to determine the effect of storage on CPDA-1 for varying periods on some hematological parameters. **Materials and methods:** The study was conducted on blood donated by 30 healthy volunteer donors. Effect of storage was analyzed at 1, 7, 14, 21 and 28 days intervals. Hematological parameters were measured using Mindary PS 300 hematology analyzer. **Results:** There is a highly significant increase in hemoglobin concentration, packed cell volume (P.C.V. %), MCV, and also a decrease in lymphocyte, granulocyte, and platelet count. The results also showed an insignificant decrease in total white blood cell count. **Conclusion:** There are degenerative changes observed in blood parameters in samples collected in citrate phosphate dextrose adenine (CPDA-1).

**Keywords:** CPDA-1; Hematological parameters; Storage.

### Introduction

Before the development of the technology involved in blood component preparation, whole blood was the only blood product available. In the 1960s, when plastic replaced glass as the collection medium, separation of whole blood into its components became possible (Kathy D, *et al.*, 2009)

Whole blood is stored in a monitored refrigerator at 1°C to 6°C for 21 days if collected in CPD or for 35 Days If In CPDA-1. The additive solution cannot be added to whole blood to increase the storage period.

Citrate phosphate dextrose adenine solution was developed in 1968 and shown to permit whole-blood

storage for 5 weeks (Shields CE, 1969). Most blood collection bags (adult) contain 63 mL CPDA anticoagulant which is sufficient to anticoagulate and ensures the viability of blood cells in 450 mL $\pm$ 10 mL blood for up to 28–35 days when the blood is stored at 2–8°C (Monica C, 2003).

When blood is stored outside the body, some hematological changes take place resulting in reduced red blood cells survival which is an important drawback when transfused into the circulation of a recipient. Preservation and long-term storage of red blood cells (RBCs) are needed to ensure a readily available, safe blood supply for

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transfusion medicine. Blood collection and storage systems licensed by the Food and Drug Administration allow red cells to be stored up to 42 days, while the median duration of storage of transfused red cell units in the United State is 15 days. Some studies have suggested that the risk of complications after transfusion increases when transfused blood has been stored for long periods (Koch CG, *et al.*, 2008).

When blood is stored in the blood bank, the biochemistry and physical properties of RBCs are altered because of storage conditions. These are referred to as storage lesions. RBC stored for some time at 4°C loses viability. Some may undergo spontaneous hemolysis while in storage; others lose the ability to survive in the recipient's circulation following transfusion (Verma M, Dahiyak, *et al.*, 2015). Under normal conditions in the body's circulation, these do not occur as optimum temperature, pH, nutrient concentration, and waste product removal are maintained (Rudmann. SV, 2005).

Storage harms RBC oxygen delivery (Bonaventura J, 2007), and emerging evidence suggests that allogeneic RBC infusion may harm some recipients. Prolonged contact of plasma with RBCs results in an exchange of contents between plasma and red cells which leads to changes in analyte concentrations as well as dilution (VermaM, *et al.*, 2015).

Platelets circulate longer when stored at room temperature and are more activated and able to form clots more effectively when stored at 4°C (Bruce-Chwatt LJ, (1972).

White cells lose their phagocytic property within 4-6 hrs of collection and become non-functional after 24 hrs of storage (Thon IN *et al.*, 2008).

Rapid degeneration of leukocytes could lead to immunomodulation related to blood transfusion. Whole blood should be leukodepleted before storage if it must be used beyond one week (Teddy C Adias, *et al.*, 2012).

## Materials and Methods

### Study area and subjects

This study was conducted in Al Ribat Hospital, located in the city of Khartoum, Sudan. The study was between 4 August and 1 September 2017. Blood (450 ml) was drawn from 30 healthy volunteer donors into Citrate Phosphate Dextrose adenine (CPDA-1) anticoagulant and placed on the quarantine shelf of the blood bank refrigerator.

### Blood collection

Blood was collected from each of the donors in CDPA-1 anticoagulant with care and adequate safety precautions to avoid contamination and infection from blood transmissible pathogens. Protective gloves were worn during collection and syringes were sterile and dry and blood collecting materials were discarded safely to avoid injury from needles and lancets. Blood bags were carefully stored in a quarantine shelf in the blood bank, with temperatures ranging from 2°-6°c (AdiasTC, *et al.*, 2012).

### Procedures:

Tests were measured using Mindary PS 300 hematology analyzer. The Mindary PS-300 auto Hematology Analyzer (china) was used; PC-300 works on the principle of electrical resistance for counting

### Results

The effect of storage on hematological parameters was evaluated. The blood was kept for 28 days and samples were examined on days 1, 7, 14, 21, and 28 for hematological parameters the mean value ( $\bar{X}$ )  $\pm$  standard error mean (SEM) are performed as shown in table (1)

**Table1:** Mean test of significance for all the days.

Parameters	Days (Mean±SD)						F	P-value
	Day (1)	Day (7)	Day (14)	Day (21)	Day (28)	Total		
TWBC *(10 <sup>9</sup> )	5.8±1.7	5.1±1.6	4.9±1.4*	4.7±1.3**	4.9±1.5*	5.1±1.5	2.4	0.057
LYMPH (%)	37.1±7.9	45.5±11.2*	64.0±19.9**	75.1±11.9**	77.4±13.5**	59.8±20.8	52.5	0.000
GRAN (%)	54.42±7.7	42.3±10.3**	24.4±14.9**	14.4±5.5**	12.7±4.7**	29.6±18.7	112.7	0.000
HBG (g/dl)	13.7±1.2	14.3±1.4	14.5±1.4*	13.3±1.0	14.2±1.7	14.0±1.4	4.3	0.003
RBC *(10 <sup>12</sup> )	4.7±0.5	4.8±0.5	4.9±0.4*	4.6±0.4	4.8±0.6	4.8±0.5	1.9	0.107
HCT (%)	41.1±3.4	43.3±3.9*	45.3±3.9**	42.3±3.3	46.2±5.6**	43.6±4.4	7.9	0.000
MCV (fl)	87.8±5.0	89.3±5.3	91.5±5.2*	92.9±5.8**	96.4±6.8**	91.6±6.3	10.2	0.000
MCH (pg)	29.1±2.3	29.4±2.1	29.3±1.9	28.8±2.3	29.7±2.2	29.3±2.2	0.7	0.614
MCHC (g/dl)	33.3±1.4	32.9±0.9	32.0±0.7**	31.3±1.2**	30.8±1.2**	32.0±1.5	24.2	0.000
PLT *(10 <sup>9</sup> )	221.7±43.4	156.7±52.4**	137.6±41.6**	127.8±32.7**	128.1±28.2**	154.4±53.4	28.3	0.000
PDW	15.9±0.3	16.1±0.5	16.2±0.4*	16.6±0.7**	17.2±.6**	16.3±0.7	29.4	0.000
PCT (%)	0.17±0.03	0.12±0.04**	0.11±0.03**	0.10±0.03**	0.11±0.03**	0.12±0.04	18.7	0.000

\*= Significant at P < 0.05

\*\*= Significant at P < 0.01

**Table1:** Mean test of significance for all the days.

#### Mean values of hematological parameters

At the end of the study period as shown in table 1 , the mean values of some hematological parameters were as follows :TWBC( 5.1±1.5 ), LYMPHOCYTES ( 59.8±20.8 ), GRANULOCYTES ( 29.6±18.7), HBG( 14.0±1.4),RBC (4.8±0.5) , HCT (43.6±4.4 ),MCV ( 91.6±6.3 ),MCH( 29.3±2.2 ),MCHC ( 32.0±1.5 ), PLT (154.4±53.4),PDW(16.3±0.7) and PCT(0.12±0.04). The P value from day -1 to day 28 were 0 .057 for TWBC, 0.000 for lymphocytes, 0.000 for granulocytes, 0.003 for hemoglobin,0.107 for RBCs ,0.000 for HCT ,0.000 for MCV ,614 for MCH , 0.000 for MCHC ,0.000 for PLT ,0.000 for PDW 0.000 and 0.000 for PCT.

#### Discussion

There is substantial evidence from in vitro studies documenting the change that hematological parameters undergo during storage. When changes observed in hematological parameters were categorized based on whether the initial days mean values were maintained when compared with other days, (below the lowest normal value), normal (within the normal range), or high (above the highest normal value), some of the hematological parameters analyzed decreased or increased.

When white blood cells (WBCs) values on day one were compared to day 7, it was observed that there

was a rapid decrease on day seven .this change in white blood cells are most likely due to the changes in sum effects of the loss of individual cell characteristics specifically degeneration that is known to occur as the cell ages. Granulocytes percentage it was observed decreased, Cohle *et al.*, 1981 and Trombridge *et al.*, 1985. There is more increase in neutrophils on day one compared to day seven and more decreased on day seven compared to day one. This is agreed with (Dacie*et al.*, 2001)when blood is a store for a longer period the neutrophils are affected. A progressing increase in lymphocytes on day seven was noticed in this study, there is more

increased in sample analysis on day seven compared to day one this agrees with (Davey *et al.*, 1986).

Hemoglobin and packed cell volume showed a drastic increase on day 7 compared to day one this is in agreement with the scientist who used turkey on their result experiment their result showed a rapid increase in hemoglobin and packed cell volume.

Platelet decrease on day seven compared to day one. This agrees with the work done by Cohle *et al.*, (1981).

### Conclusion

Blood stored for different periods of storage was found to affect hemoglobin and (P.C.V. %), they increased slightly, while no significant increase in W.B.C. count and a significant decrease in platelet count.

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