Modified Biological and Chemical Properties of Healthy Blood in Blood Bank

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Abstract

Dipolar magnetic fields with different forces were used to extend the period of storage and maintain the blood properties of the blood at period 2012 to 2013. Hematological tests showed that the magnetic exposure managed the cellular content and despite the decline in cellular contents of the blood, which was less than in the control samples for period of 5 weeks. White blood cells exactly granular cell and platelet positively act in the process. Hemoglobin did not influence with storage of blood in magnetic exposure models and control. Blood film showed decrease in clumping of red blood cells and platelets comparing while biochemical analysis showed decrease in all blood donors during a period of storage, while exposure to magnetic forces could decrease the rate changes. The best magnetic force was 1200 G.

Results of bacteriological culture were showed no growth of bacteria obtained before and after 5 weeks of storage of blood samples. That was meaning Bacteria had no role in the destruction of blood cells and no change in the blood composion during the period of storage. Finally, we could conclude that manufacturing of new blood refrigerators supplied with magnetic field to improve the quality of healthy donated blood for a longer period of storage in blood banks is highly recommended.

KEYWORDS: Magnetic field, blood bank, culture and sensitivity, bacterial contamination

1. INTRODUCTION

Blood Banks are responsible for collecting, processing and storing blood for transfusion and other purposes (Reuter R. 2004). The first anticoagulant preservative was introduced by Rous and Turner in 1916. It consisted of a citrate– glucose solution in which blood from rabbits was stored for two weeks, which prevented anemia when transfused in another rabbit who had suffered from blood loss. Then acid citrate dextrose (ACD) was introduced for clinical use. After that citrate phosphate dextrose (CPD) was used for preservation, which was less acidic than (ACD) (Gold-Aqua. 2005). Shelf- life of blood stored in (CPD) at (2- 4°C) was 21 days. In 1978 citrate phosphate dextrose adenine-1 (CPDA-1) preservative was developed. The addition of adenine improved the synthesis of ATP in the stored blood, which prolonged the storage of blood/ red cells at (2-4°C) to 35 days (Tkachenko Y. and Ojli J. H.2002).

Magnetic cell separation has become a popular technique to enrich or depleted cells of interest from a heterogeneous cell population. One important aspect of magnetic cell

separation is the degree to which a cell binds paramagnetic material. This paramagnetic material that imports positive magnetophoretic mobility to the target cells thus allowing effective cell separation (Slawinski J. 1988).

The most common suggested mechanism is that magnets might improve blood flow in underlying tissues. The field surrounding magnet therapy devices is far too weak and falls off with distance far too quickly to appreciably affect hemoglobin, other blood components, muscle tissue, bones, blood vessels or organs (Flamm, Bruce L. 2006-07). Magnetic fields can also affect the concentration of hormones, enzyme activity and synthesis of DNA (Gu , Q. 1992). The existence of unpaired electrons in four heme groups of deoxy and methemoglobin gives these species paramagnetic prosperities as contrasted to the diamagnetic character of oxyhemoglobin (Lower, Stephen. 2005).

Based on the measured magnetic moments of hemoglobin and its compounds, and on the relatively high hemoglobin concentration of human erythrocytes, we hypothesized that differential migration of these cells was possible if exposed to a high magnetic field (Zborowski M, *et al*.2 003).

The study was approved by the Ethics Committee, Medical Research Centre, Hawler Medical University.

2. MATERIALS AND METHODS

2.1 Dipolar magnetic field

Blood sample collected at period 2012 to 2013 from healthy donors (fill bag unit) and split into two parts, one half stored under magnetic forces and other under standard normal condition. Later were tested for all hematological, biochemical and microbial parameters as following:

2.2 Haematological tests (Coulter Counter Test) in Nanakali Hospital(Ministry of health Iraq, Erbil) was done for both treated with magnetic forces and untreated as a negative control for compares ,determining WBCs, DLC, RBCs, Hb, HCT, platelet count, MCV, MCH, MCHC, blood film, MPV, RDW, PDW and PCT (Smith, Hugho O., 2005) .

2.3 Biochemical tests (Coulter Counter Test) was used to test the (glucose, creatinine, uric acid, cholesterol, triglyceride, HDL- cholesterol, LDL- cholesterol, SGOT, SGPT, Alkaline phosphatase, total protein, albumin and calcium) also for both treated with magnetic forces and untreated as a negative control for compares (Chemico. 2004).

2.4 Bacteriological test:

Blood agar is used according to method of (Inc. 2003) for culture and sensitivity. Test was done for both treated with magnetic forces and untreated as a negative control for compares.

3. RESULTS

3.1 Effect of magnetic forces on blood properties

Table (1) showed results for healthy blood donors directly after drawing blood, using a coulter counter. The total count of red blood cells, white blood cells,

differential leukocyte count, platelets and intracellular and total hemoglobin were estimated. Of all donors blood sample were within normal limited.

Also the table shows the results of the analysis of the blood content within different periods of time (1-5 weeks) of incubation in blood bank, and relative decline has occurred in all measures of blood fabricated within a time. The total white blood cells have been reduced to (10^9*4.5). After the fifth week with an imbalance in the percentage of differential white blood cells in addition to the change in the appearance of cells were occurred. The ratio of lymphocytes reduced later monocyte and then the granulocyte (69.5, 21.6, 8.9 * 10^9 / L), respectively.

Shape and size of red blood cells had been also included; however the percentage of packed red blood cells increased from 37.8 to 43.9% as a result of morphological change. The MCV had increased from (83.2 to 91.6 fl) too. The Changes in red blood cell size act negatively on ratio of MCHC and decreased from (33.9 to 30.9 g / dl) as a result of disruption of the equation between the proportion of iron and the size of the cell.

Difference in the concentration of Hb and MCH were highly significant, and the ratio of Hb concentration ranged between (12.8 to 13.6 g/dl), while the ratio of MCH was between (28.2 to 28.3 pg). As noted a significant decrease in the number of platelet (178 to 80 * 10^9 /L) with storage of blood samples in a blood bank within the time.

Magnetic forces, (400 G) were used in estimate in the treatment of blood storage as a way to keep the blood properties. As in table (1) a decrease in the total number of WBCs from (6.9 to 5.5 * 10^9), but with less ratio than the standard samples which not treated with magnetic forces.

The differential WBCs (granulocyte, a granulocyte) comparing with control, it showed few changes during the first week of magnetic treatment and was the highest after that.

Blood films showed that variation in blood parameter was due to morphological change of WBCs and a greater proportion of granular blood cells. There were no significant differences in the red blood cell count, compared to the control measurement, as well as in iron, MCH and MCHC while haematocrit value affected by magnetic forces showed poorly.

The magnetic forces had positive impact on blood platelet count, where the rate of decline during the fifth week was (94 * 10^9) comparing with standard sample (80 * 10^9) platelet.

Table 1: Effects of magnetic force (400 G) on content of treated blood compared with control blood samples.

Hematological tests	Control(Mean value)						First power (Mean value)				
	Zero Time	1st week	2nd week	3rd week	4th week	5th week	1st week	2nd week	3rd week	4th week	5th week
WBC *10⁰/L	6.9	6.78	5.3	5.6	5.3	4.5	6.84	6.4	4	5.5	5.5
LYM %	17.9	26	39.2	77.4	81.7	69.5	17.7	61.6	65.3	96.8	76.3
MID %	5.9	7.5	35.8	16.5	13.7	21.6	6.7	28.4	22.4	1.4	19.4
GRA %	76.2	72	25	6.1	4.6	8.9	78	10	12.3	1.8	4.3
RBC * 10^{12}/l	4.54	4.73	4.64	4.6	4.58	4.8	4.67	4.71	4.66	4.52	4.75
Hb g/dl	12.8	13.5	13.2	13.2	13	13.6	13.4	13.2	13.3	12.9	13.5
HCT %	37.8	39.8	41.4	41.6	42	43.9	39.4	41.9	42.8	41.8	43.2
MCV fl	83.2	84.1	89.3	90.4	91.5	91.6	84.4	89	91.9	92.4	90.8
MCH pg	28.2	28.5	28.5	28.8	28.5	28.3	28.7	28	28.6	28.5	28.5
MCHC g/dl	33.9	33.9	32	31.8	31.1	30.9	34	31.5	31.1	30.8	31.4
PLT *10⁰	178	97	89	93	91	80	113	107	73	98	94

Table (2) shows the results of the use of magnetic force (800 G) in the treatment of blood samples during storage in blood banks. The total white blood cells number of were affected while the red blood cells were positively affected with magnetic force compared to control sample, despite the overall low number of platelets to ($5.8 * 10^9$) and maintains red blood cells on the same ratio.

Hb, MCH and MCHC were stabilized their value during the second force and the similar ratio as it is in the first magnetic force, as well as the case of haematocrit. The percentage of platelets were in second magnetic forces act positively comparing with control sample, whatever it is value were less than of the first power.

Table 2: Effects of magnetic force 800G on blood content compared with control sample

Haematological tests	Control(Mean value)						Second power (Mean value)				
	Zero Time	1st week	2nd week	3rd week	4th week	5th week	1st week	2nd week	3rd week	4th week	5th week
WBC *10⁹/L	6.9	6.78	5.3	5.6	5.3	4.5	6.34	6.4	3.9	5.4	5.8
LYM %	17.9	26	39.2	77.4	81.7	69.5	18.6	62	62.5	77.1	77
MID %	5.9	7.5	35.8	16.5	13.7	21.6	7.9	28.2	25.1	17.9	18.2
GRA %	76.2	72	25	6.1	4.6	8.9	72.3	9.8	12.4	5	4.8
RBC * 10^{12}/l	4.54	4.73	4.64	4.6	4.58	4.8	4.71	4.59	4.63	4.49	4.82
Hb g/dl	12.8	13.5	13.2	13.2	13	13.6	13.5	13.2	13.4	12.8	13.7
HCT %	37.8	39.8	41.4	41.6	42	43.9	39.9	40.9	42.2	41.2	43.9
MCV fl	83.2	84.1	89.3	90.4	91.5	91.6	84.7	89.1	91.1	91.8	91.1
MCH pg	28.2	28.5	28.5	28.8	28.5	28.3	28.7	28.9	28.9	28.5	28.4
MCHC g/dl	33.9	33.9	32	31.8	31.1	30.9	33.8	32.4	31.7	31	31.2
PLT *10⁹	178	97	89	93	91	80	105	115	75	95	87
MPV fl	7.8	9.5	7.9	7.4	7.1	7.4	10	7.1	6.8	6.8	6.7

The third magnetic force (1200 G) had the same effect as the second force on the total number of WBCs and RBCs as well as to the differential WBCs in stored blood samples comparing with control sample (Table 3), while the granular WBCs were less affected. The Haematocrit value increased over time with magnetic treatment and recorded the highest percentage in the fifth week (43.7%).The value of platelet were positively affected with magnetic treatment compared with control sample and recorded a count ($97 * 10^9$) platelets during the fifth week.

Table 3: Effects of magnetic force 1200G on blood content compared with control

Haematological Tests	Control(Mean value)						Third power (Mean value)				
	Zero Time	1st week	2nd week	3rd week	4th week	5th week	1st week	2nd week	3rd week	4th week	5th week
WBC *10⁹/L	6.9	6.78	5.3	5.6	5.3	4.5	4.35	3.66	3.9	5.9	5.7
LYM %	17.9	26	39.2	77.4	81.7	69.5	41.2	63	60.3	96	77.2
MID %	5.9	7.5	35.8	16.5	13.7	21.6	7.2	21.4	25.4	1.2	17.9
GRA %	76.2	72	25	6.1	4.6	8.9	51.6	15.26	14.3	2.8	4.9
RBC * 10^{12}/l	4.54	4.73	4.64	4.6	4.58	4.8	5.22	5.29	4.55	4.55	4.82
Hb g/dl	12.8	13.5	13.2	13.2	13	13.6	13.73	13.3	13.3	13.1	13.5
HCT %	37.8	39.8	41.4	41.6	42	43.9	41.13	42.2	41.4	42	43.7
MCV fl	83.2	84.1	89.3	90.4	91.5	91.6	78.87	79.73	90.9	92.2	90.6
MCH pg	28.2	28.5	28.5	28.8	28.5	28.3	26.3	24.7	29.2	28.9	28
MCHC g/dl	33.9	33.9	32	31.8	31.1	30.9	33.25	30.93	32.1	31.3	30.9
PLT *10⁹	178	97	89	93	91	80	89.66	80	77	91	97

Table (4) shows the results of the using fourth magnetic force (1600 G) in treatment of stored blood samples in blood bank and for different periods comparing with control samples. Also similar less decline in total WBCs shown (5.8 * 10^9 / L) compared to control sample (4.5*10^9/L).The differential WBCs showed positive affect with the magnetic force but with less ratio than third power comparing with control sample. The count of red blood cells kept similar during the five weeks, same in Hb, MCV, MCH and MCHC. The percentage of haematocrit relatively recorded highest (42.6 %) compared with control samples. The value of the platelets recorded (95 * 10^9/L) within the fifth week compared to the control samples (80 * 10^9 / liter).

Table (4) effect of magnetic force (1800 G) on blood content compared with control sample.

Haematological Tests	Control (Mean value)						Fourth power (Mean value)				
	Zero time	1st week	2nd week	3rd week	4th week	5th week	1st week	2nd week	3rd week	4th week	5th week
WBC *10/L	6.9	6.78	5.3	5.6	5.3	4.5	6.84	6.4	4.1	5.9	5.8
LYM %	17.9	26	39.2	77.4	81.7	69.5	19	62.3	64.4	74.9	77.8
MID %	5.9	7.5	35.8	16.5	13.7	21.6	2	28.5	23	19.4	17.3
GRA %	76.2	72	25	6.1	4.6	8.9	79	9.2	12.6	5.7	4.9
RBC * 10^{12}/l	4.54	4.73	4.64	4.6	4.58	4.8	4.75	4.67	4.57	4.59	4.72
Hb g/dl	12.8	13.5	13.2	13.2	13	13.6	13.6	13.2	13.2	13.1	13.4
HCT %	37.8	39.8	41.4	41.6	42	43.9	40.2	41.6	41.7	42.6	42.6
MCV fl	83.2	84.1	89.3	90.4	91.5	91.6	84.6	89.1	91.2	92.8	90.2
MCH pg	28.2	28.5	28.5	28.8	28.5	28.3	28.6	28.2	28.8	28.7	28.3
MCHC g/dl	33.9	33.9	32	31.8	31.1	30.9	33.8	31.6	31.6	30.9	31.4
PLT *10	178	97	89	93	91	80	107	103	80	94	95

3.2 Effect of bacterial contamination on expiration of blood:

Bacteriological cultivation were done for magnetic treated blood and control samples (non treated) at zero time and after periods of various storage times, end with fifth week storage. Results obtain no growth of bacteria isolated

3.3 Examination of blood films:

Blood film were prepared and stained to observe morphological changes at the cellular content of the blood. After a microscopic examination of blood film it was observed agglutination phenomenon of red blood cells were observed from the second week of storage blood. Increase in clumping with a time and swelling of the cells and increase in size of platelet and granular cells at the same time were noted. The granular white blood cells and platelets showed highest morphological change after the two weeks. It is concluded that morphological variation caused disruption percentages of blood cells with the changing textures note that the percentage changes were less in blood laboratories magnetic treated compared with untreated control samples.

3.4 Biochemical content of blood:

Results of samples treated with magnetic force compared with control sample as shown in table 5. Differences were found and in varying degrees in the serum of treated and control samples when compared with zero time.

The values of all parameters were decreased to half when compared with zero time (urea, cholesterol, HDL, LDL, uric acid, triglyceride, GOT, GPT, Alkaline phosphatase, albumin, and calcium). Protein levels decreased but in a small amount when compared to original value, while Creatinine completely disappeared. The value of glucose increased when compared to the value of rest of chemical content of serum.

Table (5) effect of magnetic field (1200G) on the biochemical contents of blood and compared with control

Biochemical Tests	control(Mean value)		Third power MF(Mean value)
	Zero time	2nd week	2nd week
Glucose mg/dl	147.8	239.05	228.1
Urea mg/dl	30	17.6	17.05
Creatinine mg/dl	0.93	_	0.0
Uric acid mg/dl	6.4	3.9	3.6
Cholesterol mg/dl	218.93	112.6	109.4
Triglycerides mg/dl	325.53	173	165.25
HDL cholesterol mg/dl	50.6	21.35	21.3
LDL cholesterol mg/dl	152.96	62.1	58.15
GOT U/L	33.36	18.5	18
GPT U/L	58.4	23.45	22.2
alkaline phosphatase U/L	100.36	56.95	56.1
Total protein g/dl	8	4.57	6.5
albumin g/dl	4.91	3.855	2.84
calcium mg/dl	8.89	11.5	4.54

4. DISCUSSION

From the result in Table (1) contrasting negative properties of blood with prolonged storage, which makes blood less useful to use in the traditional refrigerators in the blood banks. Our results agreed with other studies done on stored blood samples in blood bank which confirmed these studies on the decline in the proportion of organic phosphatase enzyme in red blood cells, reversely inorganic phosphatase was increased (Proctor H J et al.1971). In addition to imbalance in the salts and ions (potassium and sodium) which induced changes in stored blood in blood banks (Jhon, Mushik. 2004). And that was the point of our idea with trying to improve and maintain the properties of blood and minimize the damage caused in the cells of the blood and platelets to be better healthy status with the first results as a standard model for comparison. Negative cultivation of bacterial growth from blood samples before and after storage in refrigerator with or without magnetic treatments indicate that the bacteria had no role in changes occur in blood.

5. CONCLUSIONS:

We conclude that the blood content of cell and platelet were negatively affected in normal condition while the magnetic treatment had positive effect of the cells value and make the blood better in shape and count depending on our results of the over a period of five weeks and recommend modification process on blood storage containers in the banks of blood in order to preserve the blood. It was concluded that there were no effect of bacterial contamination valid on blood that's mean there is no growth of bacteria isolated.

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