Haematological Changes in Stored Blood

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الخلاصة

نقل الدم هي عملية اعطاء الدم أو اعطاء مكونات الدم من شخص الى الجهازالدوري لشخص آخر لعلاج الحلات المرضية، ويتم تجميع الدم في مصرف الدم.

وهذه الدراسة أجريت لتحديد تأثير هذه التغيرات على مستلمين الدم بعد اعطائهم لتجنب مضاعفات ما بعد الإعطاء. وشملت هذه الدراسة (١٢٠) نموذج دم من مستـشفى الموصـل (مركز التبرع بالدم)، (٦٠) منهم واهبين و (٦٠) آخرين مستلمين الدم و لغرض العلاج. ومن المتغيرات التي درست منها تركيز نسبة الحديد في الدم وكريات الدم البيضاء وكريات الـدم الحمر و الأقراص الدموية. ولوحظ هنالك قلة في هذه المتغيرات مع زيادة مدة الخزن.

Abstract

Blood transfusion is the process of referring blood. Or blood – based products from one person into the circulatory system of another blood transfusion may treat medical condition. The blood bank is the section of the lab that processes and distributes blood products under the supervision of a medical director certified in transfusion medicine.

This study was conducted to determine the effect of storage for varying periods on some haematological parameters.

The study include (120) blood sample admitted to Mosul Hospital (Central Blood Bank of Mosul for Blood Donation), (60) of them as normal donors and the other (60) received blood to treatment, in order to evaluate the effect of these changes on the recipients after transfusion to avoid transfusion complications as much as possible.

There is a highly significant decrease in hemoglobin concentration, packed cell volume (P.C.V. %), and also decrease in total white blood cell (W.B.C.) count and platelets.

Key words: Stored blood, blood bank, haematological parameters.

Introduction

Blood is always considered essential for life, is a mixture of cells and watery liquid, called plasma that the cells float in. It also contains other things like nutrients (such as sugar), hormones, clotting agents and waste products to be flushed out of the body. There are three kinds of cells in the blood; red blood cells, white blood cells and platelets [1, 2].

A place where blood is collected from donors separated into different types, stored, and / or prepared for transfusion to the recipient. A blood bank may be a separate free – standing facility or part of a larger laboratory in a hospital [3].

The blood transfusion was first attempted in (1422) great strides have been achieved in the field of blood donation, the discovery and recognition of the standard blood groups in (1901), the edition of dextrose to the storage medium in (1914), the importance of refrigeration of stored blood in (1937), and the discovery of the Rh factor in (1940) [4, 5].

Blood is collected into a plastic bag for blood collection consist of 450 ml of blood mixed with anticoagulants, these include citrate – phosphate dextrose (CPD), acid – citrate dextrose (ACD), with adenine to prolong red cell storage [3, 6].

The indications of fresh blood transfusion in case of anemia, leukemia, thrombocytopenia, sever liver diseases, burns, hemodialysis, hemolytic disease of new born and treatment of coagulation disorders, usually the specimen for collected is tested for hepatitis B and C, Human Immune Virus (HIV), AIDS, malaria and other infectious diseases, the only blood that tests negative for these are given to patients [2, 7 – 9].

Each unit of whole blood normally is separated into several components, red blood cells may be stored under refrigeration for a maximum of 42 days, or they may be frozen for up to 10 years. Red blood cells are used to treat anemia [10 – 12], while the platelets are important in the control of bleeding and are generally used in patients with leukemia and other forms of cancer, the platelets are stored at room temperature and may be kept for a maximum of five days, while the fresh frozen plasma used to control bleeding due to low levels of some clotting factors is kept in a frozen state for usually up to one year [2, 13 – 15].

While the granulocytes are some times used to fight infections, although their efficacy is not well – established, they must be transfused with 24 hours of donation [16, 17].

Whole blood may be preserved for up to 21 days, without losing its usefulness in blood transfusions an anticoagulant is added to prevent clotting blood plasma, the fluid portion of the blood, may be frozen and / or dried and stored indefinitely [6].

The aim of transfusing blood is to maintain or restore a medium for transport of oxygen to body tissue which is the main function of hemoglobin in the blood. This study was conducted to understand the physiology of hematological changes of blood, taking place in stored blood in the Mosul Hospitals Blood Bank, to make future blood transfusions at a level of safety.

Design

Blood transfusion involves the infusion of whole blood on blood component from one individual (donor) to another individual (recipient).

The subject can be donate blood when the age at least (17) years old, the weight at least 45.4 Kg, the subject should not donated blood in last 56 days, and the subject must be healthy.

This study consists of two parts;

Part 1: Sixty normal healthy blood donors (30 males and 30 females) with average of (29.2) years old a range of (20 – 50) years were healthy attended to Central Blood Bank of Mosul Teaching Hospital for Blood Donation.

Part 2: Sixty patients blood recipients (30 males and 30 females) with average of (27.8) years old a range of (20 – 50) years. They suffered from severe anemia of different causes and leukemia.

Blood collecting bags (Japan Medical Supply J.M.S.) used in this study contains (70 ml) of anticoagulant. Citrate phosphate dextrose adenine solution (CPD – A1), the each (100 ml) of (CPD – A1) solution contain sodium citrate (2.63 gm), citric acid (anhydrous 0.3 gm), sodium biphosphate (monohydrate 0.22 gm), dextrose (monohydrate 3.19 gm), adenine (0.027 gm), and water (100 ml). The special blood bank refrigators are used for the storage of blood at 4°C.

Complete blood picture examination in the first day was performed after three hours of storage, the one examination was carried out 2 days of storage followed by examination every 4 days up to 30 days of storage.

The following hematological investigations were measured; hemoglobin level, P.C.V.%, W.B.C. count and platelets counts.

Means, standard errors, unpaired t – test, mean comparison, coefficient of correlation and analysis of variance were carried out as described by Armitage [(18)]. Significant differences between means and control were determined by Dunnet test according to Cirk (1988) [(19)].

Results and Discussion

The hematological parameters including hemoglobin concentration g/dl, P.C.V. %, W.B.C. X 10^3/mm, platelets X 10^9/ 1 were determined by blood cell slide by Microstain, the mean value ($\bar{X}$) ± standard error mean (SEM) are preformed.

In table (1), demonstrated the level of hemoglobin and showed a non significant decrease during the first six days of storage, then by day ten it start to decrease significantly (14.72 ± 0.25) $p< 0.05$, and continue to decrease gradually and significantly to day thirty of storage.

For P.C.V. % found a non significant decrease before ten day of storage (42.7 ± 0.86 %) after that a highly significant decrease was found in P.C.V. % ($p< 0.01$) until day thirty of storage it was (37.1 ± 0.95 %) in compares on with the control at time zero (44.1 ± 0.79 %) are shown in table (2).

Platelet count in zero time of storage ± SEM (26.72 ± 13.82 X 10^9/ 1) was decreased rapidly on storage in blood bank refrigerator (table 3, figure 3), on the second day of storage there was a highly significant decrease ($p< 0.01$) in the platelets count, the platelets completely disappeared at day eight of storage.

For white blood cells show a significant decrease start from first day and continue to decrease gradually till day eight storage.

During liquid storage there is relatively rapid loss of some blood components and progressive increase in the level of undesirable products. The preserved blood in (CPD–A1) anticoagulant at 4 °C for thirty days in the Central Blood Bank in Mosul, the effect of storage on the hematological parameters of recipient blood showed a significant decrease in hemoglobin concentration, this decrease can be attributed to the hemolysis that occurs during storage. Also when blood is stored outside the body a number of changes take place in its ability of the blood cells to survive when introduced into the circulation of a recipient is decreased [12, 20 - 23].

The hematological changes of blood during storage are classified into:

1) Hemoglobin and (P.C.V.) were significantly affected by storage period of blood but (P.C.V.) is more affected than hemoglobin. This could be due to increased (M.C.V.) or real effect of age of blood, mean new blood is better than old blood in raising (P.C.V.) [7, 20].
2) While white blood cells have an abbreviated life span in stored blood (only few hours) and transfusion proved ineffective in elevating the leukocytes count, the many studies showed that during storage the total leukocyte count decreases, they attribute this decrease to degeneration of the granulocytes [24-28].

3) While platelets lose viability rapidly on storage in refrigerators, so platelets transfusion to be physiologically effective must be completed within 4 – 6 hours after blood is withdraw. The platelet viability and functions are affected by white blood cells present in stored platelet concentrate. White blood cells have adverse effect on platelets function and post transfusion recovery [21, 27].

In fresh whole blood platelets are about 60 % effective at 24 hours and almost completely ineffective after 48 hours [27 – 31].

This rapid disintegration of platelets during storage may be due to a rapid disappearance of the white blood cells; their hydrolytic enzyme the affect the platelet membrane may cause to platelet degeneration [27].

Conclusions

The transfusion of blood stored for different periods of storage, found to have effect on hemoglobin and (P.C.V.%), they increased slightly, while no significant increase in W.B.C. count and platelet after transfusion.

Transfusion of one pint of blood stored for different periods of storage, the hemoglobin and (P.C.V.%) increased slightly, non significant increase in W.B.C. count and platelet found after transfusion.

There is a significant decrease in hemoglobin concentration and packed cell volume % after one week of storage and this change increase as the time of storage increased therefore old blood can not be used for the treatment of anemia.

(P.C.V.) and hemoglobin were significantly affected by age of blood, but (P.C.V.) is more affected than hemoglobin. This could be due to increased (M.C.V.) or red effect on age of blood (i.e. new blood is better than old blood in raising P.C.V.).

Table (1): Haemoglobin values (g/dl) of blood collected during storage.

Days of storage	$\bar{X} \pm SE$	P - value
0 (Control)	16.50 ± 0.35	
2	16.23 ± 0.32	NS*
6	15.21 ± 0.31	NS
10	14.72 ± 0.25	0.05 S
14	12.10 ± 0.22	0.05 S
18	11.78 ± 0.18	0.01 S
22	11.20 ± 0.17	0.01 S
26	10.85 ± 0.16	0.01 S
30	10.75 ± 0.12	0.01 S

*** NS = Non significant**

Table (2): PCV % of collected blood during storage.

Days of storage	$\bar{X} \pm SE$	P - value
0 (Control)	44.3 ± 0.72	
2	44.1 ± 0.79	NS*
6	43.2 ± 0.82	NS
10	42.7 ± 0.86	0.01 S
14	41.2 ± 0.87	0.01 S
18	40.9 ± 0.89	0.01 S
22	39.7 ± 0.92	0.01 S
26	38.2 ± 0.94	0.01 S
30	37.1 ± 0.95	0.01 S

*** NS = Non significant**

Table (3): Platelets values (X 10^3/mm) of blood collected during storage.

Days of storage	$\bar{X} \pm SE$	P - value
0	267.2 ± 13.82	
1	261.3 ± 13.45	NS*
2	202.4 ± 9.12	0.01 S
3	175.2 ± 8.18	0.01 S
4	104.7 ± 7.52	0.01 S
5	78.3 ± 5.64	0.01 S
6	43.2 ± 4.33	0.01 S
7	22.1 ± 2.0	0.01 S

*** NS = Non significant**

Table (4): Total white blood cells value (X 10^3/mm) of blood collected during storage.

Days of storage	$\bar{X} \pm SE$	P - value
0	5.2 ± 0.28	
1	5.1 ± 0.25	NS*
2	4.2 ± 0.21	0.01 S
3	3.1 ± 0.18	0.01 S
4	2.8 ± 0.12	0.01 S
5	1.7 ± 0.09	0.01 S
6	0.9 ± 0.08	0.01 S
7	0.7 ± 0.06	0.01 S
8	0.4 ± 0.04	0.01 S

*** NS = Non significant**

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