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GAMMA IŞINLARININ KAN PARAMETRELERİ, KAN VE PLAZMA VİSKOSİTESİ DEĞERLERİ ÜZERİNE ETKİLERİNİN ARAŞTIRILMASI

THE INVESTIGATION OF THE EFFECTS OF GAMMA RAYS ON BLOOD PARAMETERS, BLOOD AND PLASMA VISCOSITY VALUES

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SUMMARY

In the present study, the effects of 2000,4000, 6000, 8000 rad doses of gamma rays used in the irradiation of blood components before blood transfusion were investigated in the autoanalyser. As for results, dose dependent decreases were observed in glucose and cholesterol levels and dose dependent increase was observed in potassium level. Some changes were also observed in the other parameters but all correlations were found to be statistically insignificant.

Following the irradiation procedure, the decreases observed in blood viscosity values measured with the cone/plate viscometer were found to be statistically insignificant, whereas the decreases observed in plasma viscosity values for the 4000, 8000 rad irradiated groups were statistically significant.

Regarding the measurements with Harkness Viscometer, the decreases observed in plasma viscosity values for 6000-8000 rad irradiated groups were statistically significant.

ÖZET

Bu Çalışmada, kan transfüzyonundan önce kan komponentlerine 2000 ,4000,6000, 8000 gibi artan dozlarda γ-ışınlarının uygulanması ile meydana gelen etkileri otoanalizörde incelenmiştir. Sonuç olarak, glukoz ve kolesterol seviyelerinde doza bağlı olarak azalma ve potasyum düzeyinde yine doza bağlı olarak artış gözlenmiştir. Diğer parametrelerde bazı değişiklikler gözlenmekle birlikte, istatistiksel olarak aralarında önemli bir ilişki bulunamamıştır.

İrradyasyon işlemini takiben, cone/plate viskozimetresi ile ölçülen kan viskozite değerlerindeki azalma, istatistiksel olarak anlamlı değilken, 4000, 8000 radyasyon aralığındaki grup için plazma viskozite değerlerindeki azalma anlamlı bulunmuştur.

Harkness Viskozimatre ile yapılan ölçümlere göre 6000,8000 radyasyon aralığında plazma viskozite değerlerinde gözlenen azalma istatistiksel olarak amlamlı bulunmuştur.

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INTRODUCTION

In leukemia, γ-irradiation is carried out to prevent the reaction of organism with the blood components before transfusion. A dose of 500 rad inhibites the reaction of lymphocytes with allogenic cells in the mixed lymphocyte cell culture (1). A dose of 1500-5000 rad decreases number of lymphocytes and platelet. The effect of irradiation and storage on erythrocytes is presently not clear (2).

Proteins are constituents of the cell as structure elements or enzymes. The irradiation doses of 1000 rad destroys the structure of proteins and enzymes. Especially, indirect effects are responsible for these situations.

The hydroxyl radicals ($OH^{\bullet}$) immediately react with aromatic and sulphur containing amino acids.The latter also reacts with H radicals .On the other hand, there is a damage on the carbon atom of glycine residue and sulphur atoms of cysteine and cystine residues when a protein itself ionises by the effect of a direct radiation reaction.

The irradition doses which effect various membranes varies in a wide spectrum. Protein synthesis in the endoplasmic reticulum membranes is extremely unreactive to irradiation. Permeability of cells to sodium and potassium ions of plasma membranes starts to change only in the doses of 10 rad (3).

The main factors which effect the viscosity of plasma are proteins mainly fibrinogen, albumin and globulins. Fibrinogen accelaretes the agregation of erythrocytes and causes the blood viscosity which forms a layer on the erythrocytes. The important factors effecting blood viscosity are hematocrit, erythrocyte agregation , platelet agregation and plasma viscosity (4-7).

These effects mentioned above suggest that γ- irradiation may also effect the blood parameters, plasma and blood viscosity. In the present work, the aim was to investigate these effects *in vitro.*

MATERIALS AND METHODS

Blood samples used in this investigation were provided from Kızılay Blood Center.The blood was centrifuged at 4000 rpm. (+4°C) for 20 minutes and plasma was obtained. The protocol contained test groups of 2000, 4000, 6000, 8000 rad doses and control groups.Irradiation of sample was performed using Oris IBL 437 C irradiation equipment.Control and test groups were left for 5 days (+ 4°C) following irradition. The blood parameters and viscosity measured on the 6^{th} day. Blood parameters were

measured using Hitachi - 717 auto analyser. The measurement of blood and plasma viscosity values were carried out using a Brookfield LV digital viscometer.Relative plasma viscosity values were measured using Harkness viscometer (LTA 6083).The following equation was used in the calculation.

$$\eta Sample = \eta H20 \times tSample / tH20$$
$$\eta H20 = 0.6915 \text{ mPa.s } (37°C)$$

RESULTS AND DISCUSSION

The effects of irradiation on the blood parameters values are presented in Table 1.

Table 1. The effects of irradiation on the blood parameters (n:7).

	Control	2000 rad	4000 rad	6000 rad	8000 rad
Glucose mg/dl	644.3± 26.2	640.0± 23.8	634.6± 22.7	628.4± 21.6	617.4± 23.2
Total protein g/dl	5.58± 0.19	5.65± 0.25	5.62± 0.22	5.50± 0.21	5.65± 0.24
Albumin g/dl	3.48± 0.21	3.50± 0.18	3.46± 0.14	3.42± 0.15	3.52± 0.19
Globulin g/dl	2.10± 0.14	2.15± 0.12	2.16± 0.12	2.08± 0.12	2.13± 0.11
Potassium mEq/L	8.87± 2.14	9.13± 2.24	9.58± 3.22	9.72± 2.42	9.98± 2.74
Sodium mEq/L	168.2± 7.4	171.7± 8.4	167.6± 7.8	172.2 8.4	170.2± 8.2
Calcium mg/dl	6.13± 0.25	6.35± 0.27	6.19± 0.22	6.50± 0.32	6.12± 0.24
Chlorine mEq/L	40.2± 5.2	38.4± 5.8	39.5± 6.1	41.5± 7.2	40.8± 6.2
Cholesterol mg/dl	157.6± 16.9	150.6± 14.4	147.2± 13.5	144.7±14.3	143.2±17.8

No significant differences were found between these blood parameters.

The plasma viscosity values related to the control and test groups which were measured by the viscometer with 60, 30, 12 rpm at 37C are presented in Table 2.

The blood viscosity values related to the control and test groups which were measured by the the viscometer with 60, 30, 12 rpm at 37 C are presented in Table 3.

The relative plasma viscosity values related to the control and test groups which were measured by the viscometer with Shear Rate = 66O s^{-1} at 37°C presented in Table 4.

Table 2. The plasma viscosity values related to the control and test groups at 37°C (n:7).

Groups	rpm	Shear Rate s^{-1}	Plasma Vis. mPa.s
Control	60	123.6	0.847±0.068
2000 rad	60	123.6	0.827±0.076
4000 rad	60	123.6	0.774±0.086**
6000 rad	60	123 6	0.786±0.084
8000 rad	60	123.6	0.766±0.080*
Control	30	61.8	0.895±0.077
2000 rad	30	61.8	0.865±0.083
4000 rad	30	61.8	0.808±0.087**
6000 rad	30	61.8	0.828±0.087
8000 rad	30	61.8	0.803±0.091*
Control	12	24.7	0.969±0.097
2000 rad	12	24.7	0.906±0.084
4000 rad	12	24.7	0.850±0.083***
6000 rad	12	24.7	0.867±0.093
8000 rad	12	24.7	0.836±0.084*

*p<0.001, **p<0.01, ***p<0.02

Table 3. The blood viscosity values related to the control and test groups at 37 C (n:7).

Groups	rpm	Shear Rate s^{-1}	Plasma Vis. mPa.s
Control	60	123.6	2.126±0.110
2000 rad	60	123.6	2.084±0.091
4000 rad	60	123.6	2.043±0.067
6000 rad	60	123 6	2.066±0.069
8000 rad	60	123.6	2.038±0.064
Control	30	61.8	2.544±0.095
2000 rad	30	61.8	2.504±0.094
4000 rad	30	61.8	2.464±0.095
6000 rad	30	61.8	2.486±0.085
8000 rad	30	61.8	2.465±0.101
Control	12	24.7	3.100±0.136
2000 rad	12	24.7	3.056±0.153
4000 rad	12	24.7	2.978±0.161
6000 rad	12	24.7	3.006±0.161
8000 rad	12	24.7	2.952±0.138

No significant differences between them.

Table 4. The relative plasma viscosity (R.P.V.) values related to the control and test groups at 37°C (n=7).

Groups	Shear Rate s^{-1}	R.P.V. mPa.s
Control	660	1.166±0.069
2000 rad	660	1.142±0.063
4000 rad	660	1.121±0.057
6000 rad	660	1.087±0.059*
8000 rad	660	1.054±0.052**

*P<0.05, **P<0.01

There is a decrease in the cholesterol and glucose values depending on the increased as the effect of ırradiation increases the breakdown of lipid and carbonhydrates. The changes observed in total protein, albumin, globulin, sodium, calcium and chlorine values show that there wasn't a dose dependent change. The dose dependent increase in potassium supports the concept that potassium is released to the irradiated blood.

The decrease in plasma viscosity following irradiation can be attributed to the structure deformation on the protein. The decrease in the blood viscosity is also related to the important decrease in the platelet production following irradiation (1500-2000 rad). Erythrocyte deformability is another important factor which effects the blood viscosity. In the case of any disease, the blood viscosity increases because of the decrease in viscosity values.This shows that the irradiation could increase the erythrocyte deformability. We believe that the future investigations which will be done on the patients who are receiwing radiation therapy will bring on important aspects into the present subject.

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