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TESTING THE IMPACT OF VIBRATION ON CHANGES IN THE NUMBER OF ERYTHROCYTES AND PLATELET COUNTS IN WHOLE BLOOD

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Abstrak

Darah atau plasma dipindahkan dari mobil unit menuju ke Unit Donor Darah menggunakan cooler box convensional tanpa adanya alat yang menjaga efek getaran sangat memungkinkan terjadi penurunan kualitas darah. Pemeriksaan yang dilakukan untuk mengetahui kualitas darah melalui pemeriksaan hematologi rutin dengan menghitung jumlah eritrosit dan trombosit. Tujuan penelitian ini untuk mengetahui dampak getaran terhadap jumlah sel darah merah dan trombosit. Desain penelitian ini adalah penelitian pre and post test with control group design. Besar sampel setiap kelompok sebanyak Sembilan tabung darah. Data diolah dengan uji one-way anova dan tukeys HSD. Hasil Terdapat perbedaan bermakna jumlah eritrosit antara kelompok yang digetarkan dengan frekuensi 11 HZ dibandingkan dengan kelompok yang digetarkan dengan frekuensi 0 HZ dan 5 HZ dengan masin- masing p value 0,00 dan 0,01. Terdapat perbedaan bermakna jumlah trombosit antara kelompok yang digetarkan dengan frekuensi 11 HZ dibandingkan dengan kelompok yang digetarkan dengan frekuensi 0 HZ dan 5 HZ dengan p value 0,00. Disimpulkan bahwa Getaran melebihi 10 Hz mampu menurunan jumlah eritrosit dan trombosit pada darah whole blood

Kata Kunci: Getaran, Eritrosit, Trombosit

Abstract

Blood or plasma is transferred from the unit car to the Blood Donor Unit using a conventional cooler box without any tools to maintain the effect of vibration which is very possible for a decrease in blood quality. Examination carried out to determine the quality of blood through routine hematological examination by counting the number of erythrocytes and platelets. The purpose of this study was to determine the impact of vibration on the number of red blood cells and thrombocytes. The research design was a pre and post test with control group design. The sample size for each group was nine tubes of blood. Data was processed by one way ANOVA and tukeys HSD test. Results There was a significant difference in the number of erythrocytes between the group that was vibrated at a frequency of 11 HZ compared to the group that was vibrated at a frequency of 0 HZ and 5 HZ with p values 0.00 and 0.01, respectively. There was a significant difference in the number of platelets between the groups that were vibrated with a frequency of 11 HZ compared to the groups that were vibrated with a frequency of 0 HZ and 5 HZ with a p value of 0.00. It was concluded that vibrations exceeding 10 Hz could decrease the number of erythrocytes and platelets in whole blood

Keywords: Vibration, Erythrocytes, Platelets

1. INTRODUCTION

Blood or plasma is transferred from the car unit (MU) to the Blood Donor Unit (UDD) of the Indonesian Red Cross (PMI) using a conventional cooler box without any tools to maintain temperature stability and maintain vibration effects. With these conditions it is possible to reduce the quality of blood during the transportation process. Empirically, the results of interviews with PMI officers in December 2020 said that one of the signs of damage to blood cells is a decrease in the number of erythrocytes and thrombocytes. Erythrocytes are said to be still good when seen from the number of erythrocytes and the number of thrombocytes themselves (Astuti et al, 2014).

Examinations carried out to determine the quality of erythrocytes can be carried out Routine Hematology examinations. The

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results of the SADT examination were seen by the morphology of the erythrocytes, whereas in routine hematological examinations the number of erythrocytes and thrombocytes was seen (Suhendra, 2015). If during transportation from the unit car to PMI UDD a lot of blood damage is found, of course it will cause losses to both the donor and PMI. On the part of the donor, the blood that has been donated will be wasted and it is not worth the inconvenience when donating. PMI incurred financial losses in terms of providing blood bags, consumables, and operating costs for mobile units. From the human resource aspect, a lot of time is wasted in the process starting from donor recruitment, donor selection and AFTAP (blood sampling).

In addition to maintaining temperature stability in order to maintain the quality of erythrocytes, it is also necessary to maintain vibration stability during transportation. The vibration frequency in the blood storage box or cooler box during transportation must be maintained not to exceed 10 Hz, because it can cause damage to the erythrocyte membrane (Ghodake & Kulkarni, 2015).

Starting from the problems above, this study will examine the impact of vibration on the number of erythrocytes and the number of platelet cells in whole blood.

2. RESEARCH METHOD

The research design was a pre and post test with control group design. study was divided into three research groups. Group A consisted of 9 vacutainer tubes containing 5 cc of blood. group B consisted of 9 vacutainer tubes containing 5 cc and group C consisted of 9 test tubes containing 5 cc of blood. Each group was vibrated with a "Blood Shaker Machine"; group A was vibrated with a vibration frequency of 0 Hz, group B which is vibrated with a vibration frequency of 5 Hz, and group C is vibrated with a frequency of 11 Hz. After shaking each group, the number of red blood cells and the number of platelets was measured.

To find out whether there were differences in the data on the number of erythrocytes and platelets, an analysis was carried out with the one way ANOVA test. Then the results of the Tukeys HSD test were read to find out the number of erythrocytes and platelets in which group there was a significant difference.

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3. RESULTS.

3.1 Overview

An overview of the number of erythrocytes and platelets in each group is presented in the table below 4.2

Table 4.2. Description of the number of erythrocytes and platelet counts at various frequencies (n: 30)

Group	Erythrocyte count (X ± SD)	Platelet count (X ± SD)
0 Hz	4.74 ± 0.47	279.50 ± 44.5
5 Hz	4.54 ± 0.43	250.8 ± 42.3
11 Hz	3.33 ± 0.71	217.6 ± 37.5

Note: (X + SD) number of cells/mm^3

In the table above it can be seen that quantitatively, there was a decrease in the number of erythrocytes and the number of platelets in the settings starting from the vibration of 5 to 11 Hz.

3.2. Analysis of the difference in the number of erythrocytes in each group.

Because the data on the number of erythrocytes and platelets was stated to be

parameter	Frequency 0 hz (X ± SD)	Frequency 5 Hz (X ± SD)	Frequency 11 hz (X ± SD)	*P value*
Number of erythrocytes	4.74 ± 0.47	4.54 ± 0.43		0.22
	4.74 ± 0.47		3.33 ± 0.71	0.00
		4.54 ± 0.43	3.33 ± 0.71	0.01

normally distributed with the results of the Shapiro Wilk test p value > 0.00, to determine the difference in the number of erythrocytes and platelets between the 5 HZ vibration treatment group, the 11 HZ treatment group and the control group. Done by using a one-way ANOVA test.

a. Differences in the number of erythrocytes

The results of the one ANOVA test to determine differences in the number of erythrocytes between groups are listed in table 4.3.

Table 4.3. The difference in the number of erythrocytes in the three groups

parameter	Frequency Vibration 0 hz (X ± SD)	Frequency Vibration 5 Hz (X ± SD)	Frequency Vibration 11 hz (X ± SD)	*P value*
Number of erythrocytes	4.74 ± 0.47	4.54 ± 0.43	3.33 ± 0.71	0,00

Note: (X + SD) number of cells/^{mm3}

In table 4.3 it appears that the significance values for all groups from the results of the one way ANOVA test show that there are significant differences from all observations in all groups, namely p value <0.05. To find out the number of erythrocytes at which vibration frequency there is a significant difference, then the HSD tukey test was carried out with the results that can be explained as follows in table 4.4

Table 4.4. Analysis of differences in the number of erythrocytes between groups with various frequencies.

Note: (X + SD) number of cells/mm^3

In table 4.4, it shows that the difference in the number of erythrocytes in the group that was not vibrated with the group that was vibrated with a frequency of 5 hz showed a p value of 0.22 (> 0.05), which means that there was no difference in the number of erythrocytes. Meanwhile, the difference in the number of erythrocytes between the blood that was not vibrated and the group that was vibrated with a frequency of 11 Hz and the difference between blood that was vibrated with a frequency of 5 Hz and blood that was vibrated with a frequency of 11 Hz showed a p value of 0.04 which means there was a significant difference in the number of erythrocytes. which means there is a significant difference in the number of erythrocytes between groups A and C and between groups B and C.

a. Differences in platelet counts

The results of the one ANOVA test to determine differences in platelet counts between groups are listed in table 4.5

Table 4.5. Differences in the number of platelets in the three groups (n:30)

parameter	Frequency Vibration 0 hz (X ± SD)	Frequency Vibration 5 Hz (X ± SD)	Frequency Vibration 11 hz (X ± SD)	*P value*
Number of platelet	279.50 ± 44.5	250.8 ± 42.3	217.6 ± 37.5	0,04

Note: (X + SD) number of cells/mm^3

According to table 4.5, it appears that the significance value in all groups from the results of the one-way anova test shows that there is a significant difference in the number

of platelets in all groups, namely the p value < 0.05. To find out the number of platelets at which vibration frequency there is a significant difference, then the HSD tukey test was carried out with the results that can be explained as follows in table 4.6

Table 4.6. Analysis of differences in the number of t platelets between groups with various frequencies

parameter	Frequency Vibration 0 hz (X ± SD)	Frekuensi getaran 5 Hz (X ± SD)	Frekuensi getaran 11 hz (X ± SD)	*P value*
Number of platelet	279.50 ± 44.5	250.8 ± 42.3		0.31
	279.50 ± 44.5		217.6 ± 37.5	0.04
		250.8 ± 42.3	217.6 ± 37.5	0.04

Note: (X + SD) number of cells/mm^3

Table 4.6 shows that the difference in the number of platelets in the group that was not vibrated with the group that was vibrated with a frequency of 5 Hz showed a p value of 0.31 (> 0.05), which means there was no difference in the number of platelets. While the difference in platelet count between blood that was not vibrated and the group that was vibrated with a frequency of 11 Hz and the difference between blood that was vibrated with a frequency of 5 hz and blood that was vibrated with a frequency of 11 hz showed a p value 0.04 (< 0.05) which means there is a difference significant number of platelets between groups A and C and between groups B and C.

4. DISCUSSION

The characteristics of the respondents as a whole are shown in Table 4.1. parameters starting from age, blood pressure, Hb levels are within normal limits, this is in accordance with Permenkes no 91 of 2015, that as a condition for donating blood all of the above parameters must be within normal limits. This is because as a donor who takes 350cc of blood to avoid post-donor hemodynamic disturbances, a healthy donor candidate must really be selected.

From the results of measurements of the number of erythrocytes and platelets before the vibration was carried out it appeared to be within normal limits, compared to blood vibrated with a frequency of 5 Hz for 10 minutes and blood that was vibrated with a frequency of 11 Hz. As stated in table 4.2. Quantitatively, there was a decrease in the number of erythrocytes and platelets. The quality of blood, both erythrocytes and platelets in blood bags, is based on several examination parameters, one of which is the number of platelets and erythrocytes.

Tables 4.3 and 4.5 based on the results of the ANNOVA test statistically show that there is a significant difference in the number of erythrocytes and thrombocytes at various vibration frequencies. Furthermore, from the results of the Tukey HSD test as shown in tables 4.4 and 4.6, there was a significant difference in both erythrocytes and thrombocytes, there were groups that were vibrated between the frequency of 0 Hz and 11 Hz and between the groups of 5 Hz and 11 Hz frequencies. In accordance with the results of Johannessen et al. (2021) research that vibrations and turbulence can affect the quality of Whole blood.

According to Soedirman (2014) there are several important factors that influence the effect of vibration on the organs of the body, one of which is the vibration threshold value. Also supported by Hariyanto (2009) states that organ disorders depend on the length of exposure, frequency and amplitude of the vibration source. The vibration duration factor also affects organ damage (Davis et al., 2014). The quality of the erythrocytes begins to deteriorate or decrease after being vibrated for more than 10 Hz. This damage occurs due to

damage to the erythrocyte cell membrane (Ghodake and Vulkarni, 2015).

Based on Price & Wilson (2012) that cells experience damage through the first several stages of damage at the level of the cell membrane so that cells will experience lysis if many erythrocyte cells experience lysis due to a vibration frequency of more than 10 Hz, of course the number of erythrocytes will decrease. The decrease in the number of erythrocytes and platelets occurs because the cells undergo karyolysis, where the cells will be destroyed (Price & Wilson, 2012). According to Zang et al., (2020) Kariolis is a body cell that is damaged and experiences permanent destruction. With the destruction, it is proven from the results of this study that after vibration of more than 10 HZ the number of erythrocyte and platelet cells has decreased from normal values. According to Abed, et al (2017) The normal value of erythrocytes in men is around 4.3 -5.6 million/mm3, while in women it is around 3.9-5.1 million/.mm3Normal platelet count is 150 – 450 k/mm3 (Ozturk et al, 2016).

5. CONCLUSIONS AND SUGGESTIONS

Based on the results of these studies, it can be concluded that vibrations exceeding 10 Hz can reduce the number of erythrocyte cells and the number of platelets in whole blood. It is recommended that in the whole blood transportation process from the location of the unit car to UDD avoid excessive vibration to maintain blood quality.

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