GENIUS JOURNAL
general nursing science journal
e-ISSN: 2723-7729
Vol. 03 No. 02 PP. 180-186 E-ISSN 2723-7729 Prefix DOI: 10.56359/gj

Design of an Information System for Testing the Blood Characteristics on Increasing the Impact of Vibration using a Prototype "Blood Shaker Machine"

Jessica Juan Pramudita[1], Edy Susanto[1], Luthfi Rusyadi[2]
[1]*Department of Medical Record and Health Information, Poltekkes Kemenkes Semarang, Indonesia*
[2]*Department of Blood Bank Technology, Poltekkes Kemenkes Semarang, Indonesia*

Correspondence author: Jessica Juan Pramudita
Email: jessicajuan_p@yahoo.com
Address : Jalan Tirto Agung, Banyumanik, Semarang City, 50268, Central Java, (024) 7460274
Submitted: 9 November 2022, Revised: 14 November 2022, 23 November 2022, Published: 2 December 2022
DOI: doi.org/10.56359/gj.v3i2.153

ABSTRACT

Objective: The general purpose of this research is to design an information system based on the application of blood characteristics testing on platelets to increase the impact of vibration by using a "Blood Shaker Machine" examined through a Haematology Analyzer (HA) and Peripheral Blood Smear (SADT) at any changes in the increase in vibration.
Method: The method used in this study is to design an application-based system on the "Blood Shaker Machine" and test the increase in vibration on changes in blood quality both in terms of the number and morphology of the platelets.
Result: Significant changes in the morphology of erythrocytes and platelets in the 10 Hz vibration group for 15 minutes also indicated a change in the quality of blood cells, both erythrocytes and platelets.
Conclusion: There is a significant difference in erythrocyte morphology changes between before and after being vibrated at 10 Hz with a p value of 0.014 and There is a significant difference in platelet morphology between before and after being vibrated at 10 Hz with a p value of 0.000.

Keywords: blood, information system, technology

Introduction

Blood is transported from the unit car (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. According to Park (2019) that damaged blood cells due to inappropriate temperature settings and the presence of a large enough vibration frequency during transportation can be seen from changes in the color of blood plasma. According to Mitchel and Peel (2009) that blood color is affected by Hb levels due to the presence of iron (Fe) contained in the Hb. Besides that, damaged blood can be seen from cell viability, namely the number and morphology. Blood, including erythrocytes, platelets and leukocytes, is said to be good when viewed from the number and morphology of the blood cells themselves (Isti et al, 2020).

Examinations carried out to determine the quality of blood cells can be carried out by means of a SADT examination (Side Blood Smear) and Routine Hematology examinations. The results of the SADT examination can be seen from the morphology of blood cells, while routine hematological examinations can be seen from the number of blood cells (Suhendra, 2015). If at the time of transportation from the unit car to UDD PMI it is found that a lot of blood damage is found, of course it will cause losses to both the donor, the blood donor unit and the patient receiving blood transfusion. On the part of the donor, the blood that has been donated will be wasted and it is not worth the inconvenience when donating. In the data donor unit, financial losses arise in terms of providing blood bags, consumables, and unit car operating costs. From the platelet aspect, a lot of time is wasted in the process starting from donor recruitment, donor selection and AFTAP (blood sampling).

In patients receiving blood transfusions or commonly called recipients, if the quality of the blood is not maintained properly, a transfusion reaction will occur. Whole blood transfusion is intended for patients with chronic normovolemic anemia or in patients who only need red blood cells (Suciati, 2010). It is estimated that 1-5% of erythrocytes will be damaged during donor collection, every day the viability of erythrocytes will continue to decrease due to decreased levels of Adenosine Triphosphate (ATP). without central polar and small size). Then this will affect the quality of the erythrocytes to be transfused (Saragih, 2019).

This opinion is strengthened by the transfusion research on experimental animals conducted by John R. (2009) found that one of the causes of the transfusion reaction of acute lung injury or Transfusion Reaction Acute Lungs Injure (TRALI) is lysophospholipid-induced oxidative damage caused by the blood storage process (John R. R., 2009). During storage, morphological changes, biochemical changes and oxidative stress can damage red blood cell membranes causing impaired deformability (Park M, et al. 2019).

In addition to maintaining temperature stability in order to maintain platelet quality, it is also necessary to maintain vibration stability during transportation. The frequency of vibrations in blood storage boxes or cooler boxes during transportation must be maintained not to exceed 10 Hz, because a large enough vibration frequency can cause damage to blood cell membranes (Ghodake & Kulkarni, 2015). The easier it is to access or store data for donors, the authors create an information system for donor data including the history of routine blood tests and blood morphology.

Beginning from the above problems, this research will conduct "Recording of Information Systems on Increasing the Impact of Vibration and Testing the Characteristics of Blood on Platelets by Testing Equipment Using a Blood Shaker Machine".

Objective

The general purpose of this research is to design an information system based on the application of blood characteristics testing on platelets to increase the impact of vibration by using a "Blood Shaker Machine" examined through a Haematology Analyzer (HA) and Peripheral Blood Smear (SADT) at any changes in the increase in vibration.

Method

The method used in this study is to design an application-based system on the "Blood Shaker Machine" and test the increase in vibration on changes in blood quality both in terms of the number and morphology of the platelets. Population: blood donors at the Blood Donor Unit, Indonesian Red Cross, Semarang. Sampling technique: control group, 5 Hz and 10 Hz treatment groups. Number of samples: 30 research samples and 60 blood tests. Research instruments: Blood shaker machine, hematology analyzer, peripheral blood smear preparation, time: six months and research location: health laboratory of Semarang District.

Results

Significant changes in the morphology of erythrocytes and platelets in the 10 Hz vibration group for 15 minutes also indicated a change in the quality of blood cells, both erythrocytes and platelets. According to Putter and Seghatchian (2017), that the presence of blood cell damage can be seen by indicators of changes in the morphology of blood.

Table.1 Differences in erythrocyte morphology changes in each group.

Parameter	Ties	Postive rank	Negative rank	P value
Changes in morphology of group erythrocytes without vibration before and after 15 minutes	9	1	0	0,32
Changes in morphology of group erythrocytes without vibration before and after 5 Hz vibration for 15 minutes	6	4	0	0,07
Changes in morphology of group erythrocytes without vibration before and after 10 Hz vibration for 15 minutes	4	6	0	0.01

In table 1, it can be seen that the vibration group with a frequency of 10 Hz from the Wilcoxon test results obtained a p value of 0.01 so it can be concluded that there was a significant change in the morphology of erythrocytes between before being vibrated and after being vibrated. The results of the p value in the control group and the group that was vibrated at a frequency of 5 Hz were 0.05, so it can be concluded that there was no significant change in erythrocyte morphology.

Table.2 Differences in platelets morphology changes in each group.

Parameter	Ties	Positive rank	Negative rank	P value
Changes in morphology of group platelets without vibration before and after 15 minutes	7	3	0	0,083
Changes in morphology of group platelets without vibration before and after 5 Hz vibration for 15 minutes	4	6	0	0,064
Changes in morphology of group platelets without vibration before and after 10 Hz vibration for 15 minutes	0	10	0	0.00

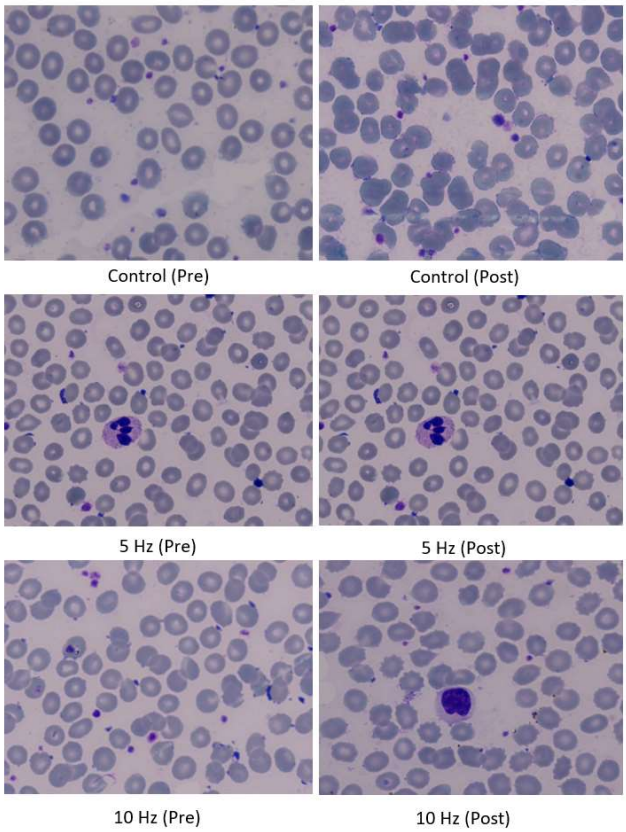

Figure 1. Results of Examination of Peripheral Blood Smear

Figure 2. The results of the design of the "Blood Tube Shaker Machine”

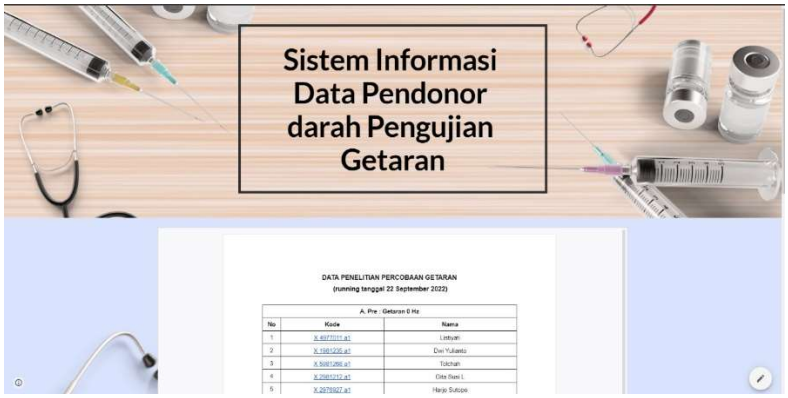

Figure 3. Information System Results Vibration Test Results Data

Discussion

The quality of blood, both erythrocytes and platelets in blood bags, is based on several examination parameters, morphology of platelets and erythrocytes. Based on the results, only the 10 Hz vibration group for 15 minutes experienced changes in morphology of erythrocytes and platelets. According to Sudirman (2014) there are several important factors that influence the effect of vibration on body organs, one of which is the vibration threshold value. Also supported by Hariyanto (2009) states that organ disturbances depend on the length of exposure, frequency and amplitude of the vibration source. The long vibration factor also affects organ damage (Davis et al, 2014). The quality of erythrocytes begins to deteriorate or decrease after being vibrated more than 10 Hz. This damage occurs due to damage to the erythrocyte cell membrane (Ghodake and Vulkarni, 2015).

Based on Prisce & Wilson (2013) that the cell is damaged through several stages, the first is damage at the cell membrane level so that the cell will undergo lysis if many erythrocytes undergo lysis due to the vibration frequency of more than 10 Hz, of course the number of erythrocytes decreases. Acording to Zang et al (2020) Karyolis is the body's cells are damaged and experience permanent destruction. With the destruction, it is proven from the results of this study that after vibrations of more than 10 Hz for 15 minutes the number of erythrocytes and platelets decreased significantly. According to Abed, et al (2017), the normal value of erythrocytes in men is around 4.3 -5.6 million/microliter while in women it is around 3.9-5.1 million/microliter. The normal platelet count is 150-450 rb/microliter (Ozturk et al, 2016).

Significant changes in the morphology of erythrocytes and platelets in the 10 Hz vibration group for 15 minutes also indicated a change in the quality of blood cells, both erythrocytes and platelets. According to Putter and Seghatchian (2017), that the presence of blood cell damage can be seen by indicators of changes in the morphology of blood cells. n this SADT examination, the morphology of blood cells can be known (Kiswari, 2014) (Arslan et.al, 2012).

Erythrocytes are one of the components of blood in the human body. Erythrocytes have a function for gas exchange. Erythrocytes carry oxygen from the lungs to the body's tissues and carry carbon dioxide out of the body's tissues to the lungs. Erythrocytes have a cytoplasm containing several organelles. Most of the erythrocyte cytoplasm contains hemoglobin which

contains iron. The presence of this iron allows erythrocytes to be able to bind oxygen (Kiswari, 2014).

Erythrocytes are cells with incomplete structures and only consist of a membrane and cytoplasm without a cell nucleus. According to Bakta (2006), there are three components of erythrocytes, namely: Erythrocyte membrane consisting of lipids and proteins, Enzyme System consisting of the enzyme pyruvate kinase and the enzyme G6DP (glucose 6-phosphate dehydrogenase) and Haemoglobin.

The morphology of erythrocytes is that they do not have a nucleus, are biconcave in shape, 7-8 m in diameter, with a bluish pink periphery and a pale pink or unstained central part. Some variations in the size, colour, and shape of erythrocytes can be seen through microscopic examination with Giemsa staining (Kiswari, 2014).

Conclusion

There is a significant difference in erythrocyte morphology changes between before and after being vibrated at 10 Hz with a p value of 0.014 and There is a significant difference in platelet morphology between before and after being vibrated at 10 Hz with a p value of 0.00.

Conflict of Interest

There is no any conflict interest.

Ethical consideration

This research was approved by the Commision of Ethic, Faculty of Public Health Universitas Diponegoro with the Number 88/EA/KEPK-FKM/2022.

Funding

This research was funded by Poltekkes Kemenkes Semarang with the contract number HK.02.03/61/0407/2022.

References

1. American Association of Blood Banks. “About Blood and Celluler Therapics”, 2008.
2. Arikunto, Suharsimi. 2010. *Prosedur Penelitian Suatu pendekatan Praktek*. Jakarta: Rineka Cipta
3. Astuti, Rini, Julia Setyati, Gunarto Dharmawan, Anna Kartika Yuli Astuti, Dewi Meika Mulyaningsih, Ag Soemantri. 2014. *Setiap Tetes Darah Anda Sangat Berharga Selamatkan Satu Nyawa Sekarang*. Semarang: Pelita Insani
4. Direktorat Bina Pelayanan Medik Dasar. 2008.*Pedoman Pengelolaan Bank Darah Rumah Sakit.* Jakarta: Departemen Kesehatan RI
5. Fitryadi, Khairil. 2016. *Pengenalan Jenis Golongan Darah Menggunakan Jaringan Syaraf Tiruan Perceptron.* Jurnal Masyarakat Informatika 7(1): 1-2
6. Ghodake VK & Kulkarni GR. 2015. Effect of Low Frequency Mechanical Vibrations on Human Blood (in vitro). International Journal of Chemical and Physical Sciences. Vol 4.
7. Homkes, Darlene M, et al. 2012. Overview of the Routine Blood Bank Laboratory. Modern Blood Banking & Transfusion Practices.6(11): 260-263.
8. Jamil, Nur Aisyah. 2007. *Teknik Sampling.* Yogyakarta: Elearnin Pendidikan Klinik Stase Ilmu Kesehatan Masyarakat

9. KEMENKES RI. 2017. *Indonesia Butuh Darah 5,1 juta Kantong Pertahun*http:// www.depkes.go.id/article/view/17071100002/indonesia-butuh-darah-5-1-juta-kantong- pertahun.html . Diakses 3 Desember 2018
10. Mentari D., Pebrina R., Nurpratami D. 2019. Storage Time Effect on pH, Glucose Level, Lactate Dehydrogenase (LDH), Calcium, and Mean Platelet Volume (MPV) Changes as A Quality Indicator of Thrombocyte Concentrate. *Biomedika.* ISSN 2085-8345Nasution, Rozaini. 2003. *Teknik Sampling*. Medan: USU Digital Library
11. Mitchell S.B and Peel Sandra. 2009. *Histology. An Illustrated Colour Text.* Churcil Living Stone.
12. Park M, Hur M, Yi A, Kim H, Lee HK, Jeon EY, et al. 2019. Utility of temperature-sensitive indicators for temperature monitoring of red-blood-cell units. Vox Sanguinis International Society of Blood Transfusion. Vol 114.
13. PERMENKES RI No.83. 2014. *Standar Pelayanan Transfusi Darah.*
14. PERMENKES RI No.91. 2015. *Standar Pelayanan Transfusi Darah.*
15. PERMENKES RI No.82. 2015. *Standar Pelayanan Transfusi Darah.*
16. Pratidina, Eki & Pupu Puspita. 2001. *Tranfusi Darah.* Bhakti Kencana Medika. 1(3): 89-95
17. Purwanto. 2008. *Metodologi Penelitian Kuantitatif*. Yogyakarta: Pustaka Pelajar
18. Rizani, Khairir, Cahya Tri Purnami, Dharminto. 2015. *Pengembangan Sistem Pendukung Keputusan Persediaan Darah di Unit Transfusi Darah Cabang PMI Kabupaten Banjar Kalimantan Selatan untuk Mendukung Perencanaan Persediaan Darah. Vol.03 No.02,* Agustus.
19. Roback, John D, et al: Technical manual, 16 ed.American Association of Blood Banks, Bethesda, MD, 2008
20. Sekaran, U. 2006*. Metode Penelitian Untuk Bisnis 1*. Jakarta: Salemba Empat.
21. Soedarmono. 2011. *Challenges Encountered in Obtaining High Quality Test for Donor Screening*. Accessed from : www.alomedika.com (12 Desember 2018)
22. Standards for Blood Banks and Transfusion Services, 27th ed. American Association of Blood Banks, Bethesda, MD, 2011
23. Sudarmanto B, Tamam M, Soemantri Ag. *Transfusi Darah dan Transplantasi.* Dalam: Nency, Yenny Movieta, Dana Sumanti. 2014. *Latar Belakang Penyakit pada Penggunaan Transfusi Komponen Darah pada Anak. Vol.13 No.3, Oktober.* Semarang: Universitas Diponegoro
24. Sugiarto. 2001. *Teknik Sampling*. Jakarta : PT. Gramedia Pustaka Utama
25. Sugiyono. 2013*. Metode Penelitiaan Pendidikan Pendekatan Kuantitatif, Kualitatif, dan R &D*. Bandung: Alfabeta.
26. Suhendra. 2016. *Defisit Stok Darah Yang Tak Kunjung Terpecahkan* https://tirto.id/defisit-stok-darah-yang-tak-kunjung-terpecahkan-bn3V. Accessed from 3 Desember 2018
27. United States Department of Health and Human Service: 2009 National Blood Collection and Utilizations Survey Report, 2011. Available at www.hhs.gov/bloodsafety
28. Utomo, K. B. (2010). *Perancangan Sistem Informasi Bank Darah Hidup untuk Mempercepat Penyediaan Calon Penyumbang Darah dengan Ketepatan yang Tinggi (Studi di PMI Kota Samarinda).*Jurnal Informatika Mulawarman*,5* (2)
29. Wahidiyat, Pustika Amalia. 2016. *Transfusi Rasional pada Anak*.Sari Pediatri 18(4):325-31
30. Wulandari, Sari. 2017. *Peran Bank Darah Rumah Sakit*. Di akses dari : https://kanal pengetahuan.fk.ugm.ac.id/ (12 Desember 2018)