Differences in HbA1c Levels in Diabetes Mellitus Patients Using Capillary and Venous Blood Samples

Teni Lestari*, Aristoteles*, Bastian*, Firna Kamilatun Nuha*
* DI IV Medical Laboratory Technology, IKesT Muhammadiyah Palembang
Email Correspondence: bastiandarwin51@gmail.com

ABSTRACT
Introduction: HbA1c is a non-enzymatic binding of glucose molecules to hemoglobin through a post-translational glycation process, measuring the level or percentage of glucose bound to hemoglobin, this parameter is used as the main benchmark for controlling Diabetes Mellitus because HbA1c can describe blood sugar levels within a period of 1-3 months due to red blood cells bound by glucose molecules. HbA1c examination is an examination of glycemic levels which is useful to determine long-term glyemic control in patients with Diabetes Mellitus. From this study to determine differences in HbA1c levels in diabetes mellitus patients using capillary and venous blood samples. Method: Cross-sectional, this research was conducted at the Hematology Laboratory of the Palembang Muhammadiyah Institute of Health and Technology. The population taken was Diabetes Mellitus Patients in the Muhammadiyah Palembang Hospital laboratory. The sample used in this study was 29 samples using purposive sampling. Results: The average HbA1c level was found in 7.91% capillary blood and 7.91% venous blood. Discussion: The conclusion in this study is that capillary and venous blood sampling can be used to check HbA1c levels.

Keywords: HbA1c, Capillary Blood, Venous Blood, Diabetes Mellitus
INTRODUCTION

Diabetes Mellitus is found in every population in the world and all regions, including rural areas in low- and middle-income countries. The number of diabetics continues to increase, according to WHO data estimates that there are 422 million adults with diabetes worldwide. In addition, the International Diabetes Federation (IDF) estimates that 1.1 million children and adolescents aged 14–19 have Type 1 Diabetes Mellitus. Without interventions to stop the increase in diabetes, there will be at least 629 million people living with diabetes by 2045. Diabetes Mellitus is a number of diseases that result in too much sugar in the blood or often called high blood glucose which causes nearly 4 million deaths each year (world health organization WHO, 2019). According to data from the Palembang City Health Office, there were 10,484 cases of diabetes mellitus in 2019 divided into several sub-districts in the city of Palembang, such as Ilir Barat II, with 345 cases of diabetes mellitus, Gandus with 577 people, Seberang Ulu I with 476 people, Jakabaring with 785 people. 745 people, Kertapati 745 people, Seberang Ulu II 579 people, Plaju 690 people, Ilir Barat I 1,101 people, Bukit Kecil 216 people, Ilir Timur I 450 people, Kemuning 562 people, Ilir Timur II 487 people, Ilir Timur III with 417 people, Kalidoni with 557 people, Sako with 614 people, Sematang Borang with 211 people, Sukarami with 1,115 people and Alang-Alang Lebar with 557 people. Diabetes mellitus is a collection of symptoms that arise in a person caused by an increase in blood glucose levels caused by impaired insulin secretion, insulin action, or both so that it has the characteristics of hyperglycemia. A person with diabetes is at risk of having higher morbidity and mortality due to complications such as kidney disease, blindness, leg amputation, coronary heart disease (Wulandari et al., 2020).

The risk of complications of DM can be controlled and reduced by controlling blood sugar levels. HbA1c parameter. Generally used as blood glucose value over a period of 1-3 months because 120 days is the age of erythrocytes, so HbA1c is used as the main parameter for controlling DM disease. HbA1c is also recommended as the ultimate goal of therapy and it is recommended to check HbA1c 4 times a year (Haryati & Tyas, 2022). Examination of HbA1c levels has many advantages over blood glucose examination, including not requiring fasting, not affected by short-term lifestyle changes, more stable at room temperature than fasting plasma glucose, more recommended for monitoring glucose control. Examination of HbA1c levels is usually indicated for patients with chronic DM (Hartini, 2016). Examination of HbA1c levels using venous blood samples is the standard for hematological examination because the veins are quite large and venous blood also has a thin and muscular wall layer which allows the veins to contract so that they have the ability to store or accommodate blood as needed. Venous blood sampling in adults is used one of the veins in the cubital fossa (Arilitha Deka Yana & Irna Yuliana, 2021).

Patients with diabetes mellitus have a weakness in taking venous blood which can affect HbA1c levels in the form of disruption of blood vessel function. Vascular disorders are prone to occur in people with diabetes. This disorder is characterized by narrowing of the arteries outside the heart and brain, which is commonly abbreviated as PVP (Arnait Christiani Tel, Ibrahim, 2021). Based on
the description above, researchers are interested in conducting research on differences in HbA1c levels in patients with diabetes mellitus using capillary and venous blood samples.

MATERIALS AND METHODS
The type of research used in this study was an experimental laboratory study with a posttest only design. The research location was in the Hematology Laboratory of the Muhammadiyah Palembang Institute of Health Sciences and Technology and the time the research was conducted was February-March 2023. The subjects of this study were Diabetes Mellitus Patients at the Muhammadiyah Palembang Hospital using the Slovin formula, 29 samples were obtained. The inclusion criteria were Diabetes Mellitus Patients in the Laboratory of Muhammadiyah Palembang Hospital, male and female sex, Examination of Glucose Levels when ≥200. The sampling technique used in this study was purposive sampling, that is, the sampling technique was carried out with certain considerations according to the desired characteristics. This sampling technique is based on certain criteria from a specific goal previously set by the researcher, subjects who meet these criteria become members of the sample. The tools and materials used were PPE, Tourniquet, Vacutainer Needle, Handscoom, Blood Lancet, Autoclick, Holder, 0.5 ml EDTA Tube, 3cc EDTA Tube, 70% alcohol swab, Dry Cotton, plaster, FIA meter plus tool, Buffer, HbA1c test strip. Research work procedures at the preanalytical stage prepare tools and materials and take samples. The analytical stage conducts an HbA1c examination and then reads it and continues with the post-analytical stage, starting from recording the results of the examination and providing interpretation of the results to reporting.

RESULTS
The research results obtained from the test "Differences in HbA1c Levels in Patients with Diabetes Mellitus Using Capillary Blood and Venous Blood Samples" were carried out at the Hematology Laboratory of the Muhammadiyah Palembang Institute of Health Sciences and Technology from February to March 2023. In this study, the HbA1c examination in Diabetes Mellitus patients used Capillary Blood and Venous Blood Samples. The purpose of this study was to find out whether there is a difference between capillary blood and venous blood on HbA1c examination and the results of the study were obtained as follows:

Average Results for Checking HbA1c Levels Using Capillary Blood and Venous Blood Samples

Based on the diagram above, the results show that the average difference in HbA1c levels using capillary blood samples and venous blood using the Immunoassay method obtains the same value, with an average HbA1c level of 7.91%.

DISCUSSION
The study used a sample of 29 respondents consisting of capillary blood and venous blood samples. HbA1c levels were then examined using the Immunoassay method. This study was
conducted to determine differences in HbA1c levels using capillary and venous blood samples in patients with diabetes mellitus.

The results of the research on examining HbA1c levels using capillary and venous blood samples in diabetes mellitus patients obtained the same average of 50% so that the two samples could be used as alternative samples in examining HbA1c levels. To further clarify the relationship, a statistical test was carried out using the SPSS program and a non-parametric Mann Whitney test was carried out to obtain a value of \( p = 0.785 \). The results of these tests indicate that the hypothesis put forward in this study is that there is no significant difference in examining HbA1c levels using capillary blood and venous blood samples. Examination of HbA1c levels using capillary and venous blood samples did not have a significant difference. Basically, venous blood and capillary blood are the same, are in one blood circulation cycle that are interrelated and both can be used as samples for Clinical Chemistry tests, especially for checking HbA1c levels. Differences in venous and capillary blood apart from the process of taking blood samples, there are differences based on their arrangement, namely veins are more complex and larger in structure so that the number of cells is also small. Venous blood contributes to the macro-circulation of blood, while capillaries function in the micro-circulation (Widianto et al., 2021).

The blood component is the only fluid in the body's tissues. Blood is a special form of connective tissue, in which living blood cells are suspended in a non-living fluid matrix called plasma. Blood has several functions that support human life and metabolism, namely related to respiration, namely transporting \( O_2 \) from the lungs to the tissues and \( CO_2 \) from the tissues to the lungs, related to nutrition, namely transporting food extracts absorbed from the small intestine throughout the body, and related to tissue repair. Several fractions of body cells, such as basophils and platelets, produce compounds that function to repair tissue damage. Capillary blood is a very small blood vessel that connects the arterial and venous circulations. Thus, capillary blood is a mixture of arterial and venous blood. Capillary blood sampling can be performed on adult and pediatric patients with indications. The condition of the veins is fragile, the patient has serious burns, and the venous blood sampling is not successful and the examination parameters to be carried out using capillary blood (Eva ayu, 2019).

In examining HbA1c levels using the Finecare Fia Meter Plus, apart from being able to use venous blood samples, you can also use capillary blood using whole blood samples. Examination of HbA1c levels has many advantages so it is more recommended for monitoring glucose control. This examination does not require fasting, is not influenced by short- term lifestyle changes, is more stable at room temperature than fasting plasma glucose. HbA1c examination is more beneficial clinically because it can provide clear information about the patient's condition and how effective the diabetes therapy is. HbA1c examination is more accurate than fasting blood glucose and 2 hours postprandial blood glucose in monitoring the control of diabetes mellitus, because HbA1c is contained in erythrocytes that live for 100-120 days. If the HbA1c level is poor or increased, then the HbA1c level reflects poor control of glucose metabolism over the past 3-4 months (Sartika & Hestian\textquotesingle, 2019). This research is in line with research that has been conducted by (Bastian et al., 2022). Examination of CRP levels using capillary blood and venous blood had no difference from the results obtained. Examination of CRP
levels always uses venous blood samples, so from this study it can be roven that the use of capillary blood in examining CRP levels has the same value as examinations using venous blood. Therefore examinations using capillary blood can be used as a reference for examinations that are easier to do.

According to (Keramati et al., 2014) to the results of a strong correlation between hemoglobin A1c values measured using capillary and venous blood samples. The ROC curve analysis shows that when tested using the CERA STAT 2000, capillary hemoglobin A1c measurements have a fairly high value in patients with diabetes mellitus who are not well controlled and well controlled. According to (Puspitasari et al., 2020) There was no statistically significant difference between the average results of the examination of hemoglobin levels by the capillary blood POCT method and the venous blood cyanmethemoglobin method. In this study it can be concluded that there is no difference using capillary blood and venous blood in examining HbA1c levels seen from the nonparametric test, namely the Mann-Whitney test. So that the HbA1c examination using capillary blood samples and venous blood can be used in the examination. The amount of blood taken from the veins is more than the amount of blood from the capillaries. From the results of this study using venous and capillary blood samples in examining HbA1c levels, of course there was no difference from the results obtained. If so far we have always used venous blood samples to check HbA1c levels, so this study can prove that the use of capillary blood in checking HbA1c levels has the same value as examining using venous blood. Capillary blood has the advantage that capillary blood examination is relatively easy to obtain because there are several parts of the body (heels, fingertips and ears). Therefore, examination using capillary blood can be used as a reference for examinations that are easier to do.

CONCLUSIONS AND SUGGESTIONS

Conclusion

Based on the results of research on differences in HbA1c levels using capillary and venous blood samples using the immunoassay method, it can be concluded as follows:

1. Examination of HbA1c levels obtained an average HbA1c level in capillary blood samples, namely 7.917%

2. Examination of HbA1c levels obtained an average level of HbA1c levels in venous blood samples, namely 7.910%

3. The average HbA1c level examination results obtained an average HbA1c level in capillary blood samples of 50%

Suggestion

As for suggestions that can be conveyed by the author to readers, namely:

1. For future researchers, the results of this study can be used as a comparison and reference material for research with different clinical chemistry examination parameters. This research can be continued by examining HbA1c levels in venous and capillary blood samples which are examined immediately and postponed.

2. Examination of HbA1c levels can be done using other methods such as HPLC

FUNDING
This research uses private funds from researchers

CONFLICT OF INTEREST
There is no possibility of conflict of interest in the publication of this article.

THANK-YOU NOTE
Thank you very much to all parties who have helped and facilitated the implementation of this research activity so that it was carried out according to the plans that had been prepared.

LITERATURE

Amin, M., & Oktavia, B. (2020). Aplikasi Teknik Kromatografi Ion pada Penentuan Kadar Mineral Mikro Kation (Na+, NH4+, K+, Mg2+, Ca2+, Ba2+, dan Sr2+) dan Anion (F-, Cl-, Br-, NO2- , NO3-, SO42–, dan PO43-) dalam Sampel Air Panas Bumi untuk Tujuan Balneoterapi. *ALCHEMY Jurnal Pemilikan Kimia*, 16(2), 171. [https://doi.org/10.20961/alchemy.16.2.36210.171-178](https://doi.org/10.20961/alchemy.16.2.36210.171-178)


---

**Health Innovation to Improve Quality of Live in Industry 5.0 Era**

---