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RELATIONSHIP BETWEEN SPECIFIC GRAVITY OF CUPRIC SULFATE AND SATURATION OF BLOOD DROPLETS DURING DONORS' HEMOGLOBIN SCREENING

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ABSTRACT

There are several methods of hemoglobin screening. A technique that is practical, easy, and fast, as well as does not require high costs is needed for blood donor activities. Cupric sulfate method is still used in blood donor activities nowadays. There are several types of the specific gravity of cupric sulfate which will determine saturation speed. On the other hand, one of the requirements for a blood donor, according to the WHO, is that its hemoglobin level must be ≥ 12.5 g/dL. This research aims was to reveal how many blood droplets could be dripped into cupric sulfate solutions at certain specific gravities. This research was an observational analytic study using a cross-sectional design. One mL of venous blood sample was consecutively collected from thirty donors who came to the blood service of the Dr. R. Soedjono Selong Hospital in August 2017. Next, screening for hemoglobin levels was carried out on those blood samples using the cupric sulfate method with a specific gravity of 1.054. Autoanalyzer was also used as a reference method in this research. Results of cupric sulfate examination were categorized into sinking and non-sinking. The results of cupric sulfate examination with sinking category showed significant suitability with hemoglobin levels of >12.5 g/dL from autoanalyzer (p=0.002) with 100% sensitivity and 70.83% specificity. The results of cupric sulfate examination with non-sinking category (with daily replacement) showed a significant match with hemoglobin levels of >12.5 g/dL from autoanalyzer (p=0.003) with 68% sensitivity and 100% specificity. The use of ten samples in this research could reach 100% sensitivity and 100% specificity. Meanwhile, according to the WHO, 30 mL of cupric sulfate solution with a specific gravity of 1.053 can accommodate 25 donor blood droplets. Thus, it can be concluded that unlike the reference from the WHO of 25 droplets, based on hemoglobin screening test cupric sulfate solution with a specific gravity of 1,054 can be saturated with ten droplets.

Key words: Hemoglobin screening, cupric sulfate, specific gravity, blood droplets, autoanalyzer

INTRODUCTION

The high Maternal Mortality Rate (MMR) due to bleeding leads to an increase in blood demand in hospitals. Continuous blood availability, as a result, is needed to anticipate it. Voluntary blood donor mobilization should be conducted to fulfill blood availability.[1,2]

One of the requirements for taking a blood donor, according to WHO is hemoglobin level of ≥ 12.5 g/dL.[1-3] Hb screening, including pre-blood donation screening, must be carried out. There are several methods for hemoglobin screening, namely cupric sulfate method, hemoglobin color scale, hemoglobin Sahli, cyanmethemoglobin, hemoglobinometer, and using an autoanalyzer. Unfortunately, the screening, including pre-blood donor screening to find out donor hemoglobin, not only has advantages, but also disadvantages. For blood donor activities, as a result, a method that is practical, easy, and fast, as well as does not require high costs is needed. The cupric sulfate method is still used in blood donor activities nowadays. There are several kinds of the specific gravity of cupric sulfate which will determine saturation speed. According to the WHO, 30 mL of cupric sulfate solution with a specific gravity of 1.053 can accommodate 25 donor blood droplets to become saturated.[2,4-7]

The general objective of the research was to determine the relationship between the specific gravity of cupric sulfate and the saturation of blood droplets during donor hemoglobin screening. The specific objectives of the research were to determine the sensitivity and specificity of hemoglobin screening on donorblood using the cupric sulfate method during the screening of the donor's hemoglobin; to find out the appropriate amount of blood droplets that can be dripped into cupric sulfate solution in various conditions with certain

specific gravities during the screening of the donor's hemoglobin and to identify the relationship between the specific gravity of cupric sulfate and the saturation of blood droplets during the screening of the hemoglobin donor.

METHODS

This research was an observational analytic study using a cross-sectional design. Samples in this research were 30 donors EDTA blood which were examined for hemoglobin in the Laboratory of Blood Installation Services at the Dr. R. Soedjono Selong Hospital, in East Lombok. Data were consecutively collected during August 2017. The samples then were examined using cupric sulfate method. Afterward, the samples were duplicated and replicated. Autoanalyzer measurement was also used as a reference method in this research.

Subsequently, screening of hemoglobin was performed using cupric sulfate method based on specific gravity. The principle of this method is that a drop of whole blood (20 µL) dripped into cupric sulfate solution with a specific gravity of 1,054 will maintain its density for approximately fifteen seconds. After that, the movement of blood droplets was observed whether they were sinking or floating. In this research, 30 mL of cupric sulfate solution was used with several treatments, namely sample replacement, daily replacement, and weekly replacement. The cupric sulfate solution was prepared and standardized (BJ 1,054) before used in accordance with the Standard Operating Procedure (SPO).[4] Donor Next, autoanalyzer as the reference method was used to examine hemoglobin. The hemoglobin screening with the autoanalyzer was carried out using Sysmex XS 800i analyzer. This analyzer measures hemoglobin with a non-cyanide method, namely Sodium Lauryl Sulphate (SLL). Before the autoanalyzer used to collect blood samples from the patients, it was calibrated once a year, and quality control for this equipment was also carried out every day. The statistical analysis using Chi-Square test at a 95% confidence level was conducted to determine the relationship betweenthe specific gravity of cupric sulfate and the saturation of blood droplets during the screeningof the donors'hemoglobin. Sensitivity and specificity values then were calculated.The research flow can be seen in Figure 1.

RESULTS AND DISCUSSION

The results of the cupric sulfate examination were categorized into sinking and non-sinking. Thirty samples were obtained, consist of 16 female (53%) and 14 male (47%) with average of age 37.6±7.1. The results of the cupric sulfate examination with sinking category (sample replacement) showed significant suitability with the hemoglobin level of > 12.5 g/dL from autoanalyzer (p=0.002) with a sensitivity value of 71% and a specificity value of 100%. Meanwhile, the results of the cupric sulfate examination with daily replacement showed a significant match with the hemoglobin level of > 12.5 g/dL from autoanalyzer (p=0.003) with a sensitivity value of 68% and a specificity value of 100%. It means that the use of 10 samplesonly could reach 100% sensitivity

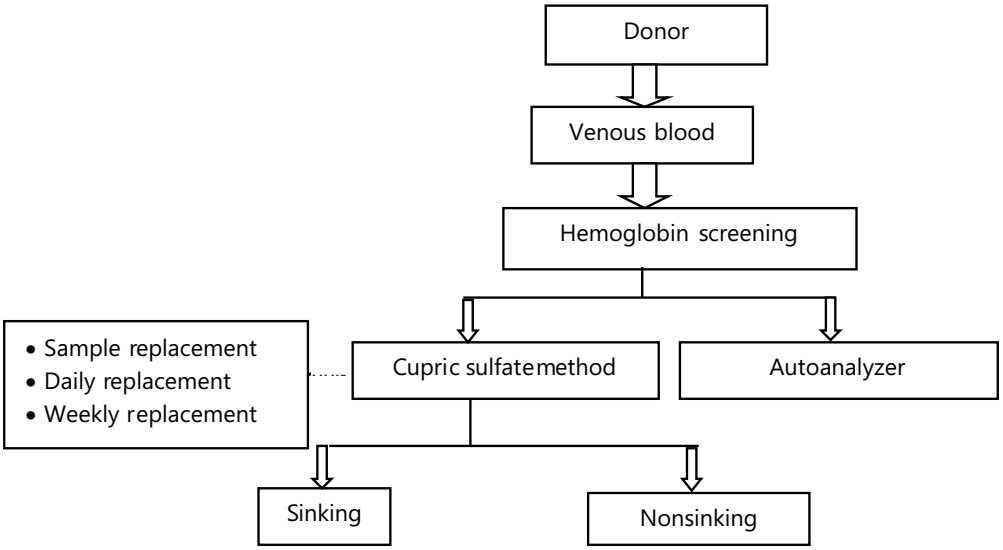

Figure 1. The research flow

Table 1. Diagnostic value of the cupric sulfate method on the donor's hemoglobin screening

Statistical analysis	Diagnostic sensitivity (%)(CI 95%)	Diagnostic spesificity (%)(CI 95%)
Cupric sulfate of sample replacement	71 (48.9 – 87.4)	100 (54.1 – 100)
Cupric sulfateof daily replacement	68 (46.5 – 85.1)	100 (54.1 – 100)
Cupric sulfateof weekly replacement	63 (38.4 – 83.7)	100 (2.5 – 100)
Cupric sulfate of 10 samples replacement	100 (54.1 – 100)	100 (39.8 – 100)

and 100% specificity. In other words, if cupric sulfate solution is replaced weekly, it can reach 63% sensitivity and 100% specificity. But, if it is only used on 10 samples for one day, its sensitivity and specificity values will become 100% (Table 1).

Afterward, the hemoglobin screening with the cupric sulfate method was carried out based on specific gravity. The principle of this method is that a drop of whole blood dripped into cupric sulfate solution with a specific gravity of 1,054 will maintain its density for approximately fifteen seconds. Unfortunately, this method still has some weaknesses, such as bubbles appeared in the samples and less precisely dripping (less than one meter from the edge over the solution) leading to false-low results on hemoglobin screening. Consequently, the donor will not pass the requirements for a blooddonor. High or low levels of protein can also cause false results.[4-6]

Finally, the results of this research indicated that the use of cupric sulfate solution substituted for each sample and every day (ten samples) showed higher sensitivity and specificity than if the solution was dripped more than ten droplets and more than one day. This phenomenon can be caused by not only changes in the specific gravity of the cupric sulfate solution affecting the movement of blood droplets with certain specific gravity, but also the presence of evaporation factors or humidity.

CONCLUSION AND SUGGESTIONS

In conclusion, hemoglobin screening with cupric sulfate method with a specific gravity of 1,054 can be saturated for ten blood droplets. In contrast, the reference from the WHO states that it can be saturated for 25 blood droplets. Screening using the cupric sulfate method can still be used for primary screening with high sensitivity, low cost, and friendly-use. Never the less, further researches are suggested to focus on other variables that can affect the specific gravity of cupric sulfate solution.

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