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COMPARISON OF PORTABLE HEMOGLOBIN PHOTOMETER AND AUTOMATED HEMATOLOGY ANALYZER IN MEASUREMENT OF HEMOGLOBIN LEVELS FOR BLOOD BANK DONORS AT PRINCESS IMAN CENTER FOR RESEARCH AND LABORATORY SCIENCES

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ABSTRACT

Background: In any blood bank, screening for anemia by hemoglobin level measurement is an essential step preceding blood donation. **Aim**: This study aimed to determine the accuracy of hemoglobin measurement by finger stick using the portable hemoglobin photometer (PHP) CompoLab TS (Fresenius Kabi GmbH). **Methods**: We recruited a total of 270 randomly selected blood donors in the blood bank of Princess Iman research and laboratory sciences Center at the Jordanian Royal Medical services between October 2018 and February 2019. Capillary samples were collected by finger sticking and hemoglobin concentrations were measured by CompoLab TS (Fresenius Kabi GmbH). Reference venous hemoglobin levels were measured using the automated Sysmex XN1000 analyzer. Results were analyzed using Microsoft Office Excel 2007. **Results**: Among the 270 subjects in this study, the mean (SD) of capillary PHP hemoglobin and venous Sysmex hemoglobin were 15.56 (1.79) and 15.10 (1.72) g/dL, respectively. Pearson's correlation coefficient (r = 0.93) suggests a strong positive correlation. The bias (limits of agreement) was 0.47 (-0.79, 1.72) g/dl and the accuracy in donor categorization was 96.7%. **Conclusion**: The PHP categorized blood donors to high accuracy and the correlation between its hemoglobin concentrations and those of the automated hematology analyzer was excellent with a small overestimation over reference . Therefore, we recommend the use of PHP as a suitable screening method for anemia at our blood bank. **Abbreviations**: PHP = portable hemoglobin photometer.

KEYWORDS: Hemoglobin measurement, Portable hemoglobin photometer, Blood bank.

INTRODUCTION

All over the world, patients with various health problems need the help of blood donors on a daily basis. The world health organization estimates the optimum level of blood donation at 10 units per 1000 population needed to bridge the gap between demand and supply.[1] The blood donation rate at the blood bank of Princess Iman research and laboratory sciences Center ranges between 120-160 daily units with (450-500) ml of blood collected by venesection (phlebotomy) in each donation. Eligibility criteria are required for donor qualification to ensure the safety of both donors and recipients as well as the adequacy of the blood components available for transfusion.[2] Donors who do not meet such requirements are deferred (disqualified), either temporarily or permanently. A hemoglobin level minimum of 12.5 g/dL and 13.5g/dL for females and males, respectively, is one of these criteria that protects anemic donors by keeping them from blood donation.[2,3] Globally, anemia is a well-documented deferral factor leading to about 10% deferral rate.[4] It is reported in many developing countries as the major cause of temporary deferrals and second to infection in overall deferrals.[5-9]

Many recent studies encourage the use of portable hemoglobin photometer (PHP) devices.[10,11] PHP devices not as costly as fully automated devices. They make the donation process short and comfortable for donors and blood bank workers. In mobile collection settings including donation campaigns, portable, chargeable devices are advantageous. Moreover, finger sticking preserves the site of venous access for the donation process.

The aim of this study is to evaluate the PHP device's accuracy and reliability.

METHODS

The study was approved by the ethics committee of the Royal Medical Services in Amman, Jordan.

A total of 270 blood donors were included in our study at Princess Iman Center for Research and Laboratory Sciences over a time period between October 2018 and February 2019. Two hundred and twenty-one of the total (81.9%) were males and 49 (18.1%) were females and their ages ranged between 19 years and 59 years (mean = 32.5 years).

We collected three ml of venous blood from each donor into ethylenediaminetetraacetic acid tubes. Samples were immediately sent to the hematology department of our central laboratory and hemoglobin levels were measured using the fully-automated Sysmex hematology analyzer XN1000 within 1 hour. Blood was also drawn by finger stick after disinfecting the fingertip with an alcohol swab. Avoiding squeezing ('milking"), the first drop of blood was wiped away and the next was placed on a microcuvette. The PHP on site instantly measured hemoglobin levels using the azide-methemoglobin method and results were acquired within seconds. Properly trained technicians followed standard operating procedures using manufacturer external control samples every day and calibration, when needed, to ensure quality control of the two instruments previously mentioned.

Data was collected and transcribed onto a Microsoft Excel spreadsheet to be further analyzed.

We considered hemoglobin levels < 12.5 g/dL and 13.5g/dL for females and males, respectively, as the lower thresholds for deferral.

RESULTS

Among the 270 subjects in this study, the mean (SD) of capillary PHP hemoglobin and venous Sysmex hemoglobin were 15.56 (1.79) and 15.10 (1.72) g/dL, respectively. This shows that the PHP yielded higher results with a bias (SD) of 0.47 (0.64) g/dL and a relative error of 3.1%. Pearson's correlation coefficient (r = 0.93) suggests an excellent positive correlation. The upper and lower limits of agreement were -0.79 and 1.72 g/dL.

The overall deferral rate due to anemia was 11.5%. Seven donors were given false passes (having normal PHP results but low reference results by Sysmex), yielding a 2.2% false-pass rate. Also, three donors received false deferrals (Table 1).

The accuracy of the PHP as a screening point-of-care device was 96.7%. It was calculated by the sum of the correct passes and correct deferrals divided by the total number of donors. Sensitivity and specificity were 89.3% and 97.5%, respectively.

DISCUSSION

We continuously aspire to improve the blood donation experience at our center to help maintain adequate blood supply. A proper hemoglobin screening method for donors allows accepting the largest number without putting anemic donors at risk. CompoLab is a broad spectrum PHP and its reagent-free cuvettes are cheap with a long shelf-life of 2.5 years. In this study we found an excellent correlation between the PHP and Sysmex results with a high Pearson's coefficient value (r = 0.93). The mean of PHP hemoglobin levels was higher than that of the reference method supporting the previous literature observations of hemoglobin overestimation with capillary blood, wherein the bias is inherent due to different sample sources and composition.[10,13,14] The magnitude of difference, however, is small (0.47 g/dL) and the donor categorization accuracy was high. According to De Clippel et al, CompoLab correctly categorized the majority of donors providing high safety levels.[15] Moreover, measuring hemoglobin levels without dilution in its microcuvettes is similar to HemoCue devices and was found superior by Schenck et al.[16]

Tables and Figures

Table 1: Anemia deferrals according to gender and hemoglobin measurement method.

Characteristics	Number of donors	Sysmex anemia deferrals	PHP anemia diferrals
Female	49 (18.1%)	18 (36.7%)	16 (32.7%)
Male	221 (81.9%)	13 (5.9%)	12 (5.4%)
Total	270 (100%)	31 (11.5%)	28 (10.4%)

CONCLUSION

PHP hemoglobin levels were comparable with the Sysmex automated analyzer and gave highly accurate results in categorizing donors. Bias can be decreased by improving staff competency in obtaining reliable results which in turn can be attained by training, detailed documentation, and appropriate performance evaluation. Donor deferral can be decreased by implementing second line testing using automated analyzers for borderline readings.

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