First or Second Drop of Blood in Capillary Glucose Monitoring: Findings from a Quantitative Study

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Introduction: For clinical nurses, especially those working in emergency departments, it is crucial to measure blood glucose (BG) in an accurate, timely, and safe manner. Many differences in practice exist with regard to use of the first or second drop of blood for testing, and no consistent guidelines are available for capillary BG testing at home or in ED settings. The purpose of this study is to evaluate the BG differences between the first and second drop of capillary blood collected from the same site in patients with type 1 diabetes.

Methods: A consecutive sample of 195 persons with type 1 diabetes who had washed their hands and were not suspected of having hypoglycemia were included in the study. Descriptive and inferential statistical analysis for non-normal distributed variables was performed.

Results: A strong correlation emerged between the BG reported in the first and the second drops (Spearman's rho test [r_s] 0.979, $P < .001$; Pearson r 0.978, $P < .001$). The average BG values obtained from the first and second drops were 184.30 mg/dL (median, 166) and 187.6 mg/dL (median, 172), respectively, and thus the second drop showed higher glucose values compared with the first drop. However, BG values of the second drop were not higher in all occasions: whereas some evaluations reported higher BG values in the second drop capillary sample (n = 123), others reported higher values in the first drop (n = 65), and still others reported identical measurements in the first and second drops (n = 7). Five outliers were present with a BG difference from −39 to −53 mg/dL in the first drop compared with the second drop, and 3 outliers were present with a BG difference from +46 to +57 mg/dL in the first drop compared with the second drop. However, the differences that emerged were not affected by glucose concentration ($P = .221$).

Discussion: Using the first drop of blood in a patient with clean hands allows emergency nurses to perform the test more quickly, resulting in immediate information. Findings indicate that the first drop of blood is adequate for clinical decision making, but the clinician should use judgment if using protocols in which small values (eg, 6 mg/dL) are important, because the first drop is more likely to have a slightly lower value.

Key words: Accuracy; Blood glucose evaluation; Capillary; Drop of blood; Emergency nurses; First drop; Second drop; Nursing

According to the International Diabetes Federation, the incidence of diabetes mellitus has increased considerably in all countries.[1] Health care professionals regularly encounter patients with altered blood glucose (BG) levels in a variety of outpatient clinics, emergency departments, and hospitals.[2] The purpose of this study is to evaluate the BG differences between the first and second drop of capillary blood collected from the same site in patients with type 1 diabetes.

Most patients admitted to the hospitals are first evaluated by ED teams, and hyperglycemia is one of the most common problems detected.[3] In critically ill patients, hyperglycemia has been associated with poor clinical outcomes,[4] especially in persons affected by trauma, in whom increased infections, multiple organ failure, and mortality have been documented.[5–8] However, hypoglycemia is also reported as a common problem in emergency departments[9]; it has been estimated that from 2% to 4% of deaths in persons with type 1 diabetes are attributable to

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J Emerg Nurs 2016;42:420-6.
Available online 12 May 2016
0099-1767

http://dx.doi.org/10.1016/j.jen.2016.03.027

hypoglycemia.[10] In addition, detecting altered BG levels is also important to identify persons with undiagnosed prediabetic conditions. Early identification of slightly elevated BG levels allows health care professionals to initiate an educational intervention, giving patients the opportunity to make choices to prevent or delay complications,[11] thus avoiding negative outcomes.[12]

BG measurement accuracy is crucial to appropriate and timely clinical decisions, especially during emergency care such as that provided in ambulances, where the most common procedure adopted entails sticking a finger with a lancet device to obtain a small blood sample. Although this procedure is easy, fast, and safe, there is still no agreement regarding whether the first or second drop of capillary blood should be used for testing.[13] The first drop could contain more interstitial fluid, which differs slightly in glucose concentration; therefore, dilution of the first drop of blood with interstitial fluid may lead to lower BG values.[13] However, in highly perfused skin such as fingers, the glucose concentration in blood and interstitial fluid should be almost the same and thus should not affect the BG measurement accuracy.[14] For clinical nurses, especially those working in emergency departments, it is crucial to measure the BG in an accurate, timely, and safe manner. Advancing knowledge of the accuracy of BG measurements, aimed at improving the accuracy and quality of the measurements and consequent decision making, was the general intent of this study.

Several previous studies examined the differences in BG levels in a different context, such as with soiled hands or different sites—for example, capillary to venous. In one study, in 53 healthy volunteers, no differences between the first and second drops of capillary blood from finger sites were found.[14] Another study in healthy volunteers evaluated the effect of fingers soiled with products containing sugar (eg, dextrose, fruit, jam, honey, and chocolate paste) and the effect of disinfection with chlorhexidine in removing traces of glucose.[15] Sequential drops of blood were obtained in different conditions: (1) after "intervention 1," which was based on sequential evaluation of the first, second, and third drops from soiled fingers; and (2) after "intervention 2," in which the BG measurement was performed using the first drop from soiled fingers, after which finger disinfection was performed and sequential BG measurement was performed using the second and third drops. The BG concentration in the third drop was 10% higher than the control measurement obtained in washed hands with neutral soap. In both interventions the highest glucose concentrations were found in the first drop of blood, with a significant decrease in sequential BG concentrations from the first drop of blood to the control.[15] Further studies are needed in persons who have diseases or disorders that alter BG, in addition to persons who are healthy.

In a study involving 123 patients with diabetes, BG levels using the first and second drops of blood in different circumstances were measured: (1) without washing hands, (2) after handling fruit, (3) after washing the fruit-exposed hands, and (4) during the application of different amounts of pressure around the finger.[16] The effects of different circumstances were evaluated; according to the findings, the first drop of blood was adequate for self-monitored glucose testing, but only after having washed the hands. When hand washing is not possible, or in case of visible soiled fingers, using the second drop of blood after wiping away the first drop was suggested.[16]

In a recent study of 526 hospitalized patients, the accuracy of the first or second drop of blood obtained from different finger sites was compared with venous BG, which was considered the gold standard.[17] No significant differences in the BG concentration were obtained from the first drop, the second drop, and the venous sample of blood. However, after stratifying the evaluations into 6 groups according to glucose concentration, differences were found in the groups reporting values of glucose <9.9 mmol/L and between 20 to 30 mmol/L. According to the findings, the first drop was more accurate in the group reporting a <9.9 mmol/L glucose concentration, whereas the second drop was more accurate in the group reporting >20 mmol/L with respect to the venous measurement. As previously reported, studies regarding differences, if any, between the first and second drops have mainly regarded BG measurements performed with healthy subjects, patients whose hands were exposed to dirt (soiled fingers and unwashed hands), or comparing hospitalized patients' BG accuracy to venous blood sampled. Our evaluation focused on the differences of first and second drops of capillary blood in patients who had type 1 diabetes with cleanly washed hands in the outpatient setting.

Methods

AIM AND STUDY DESIGN

This quantitative study evaluated the differences between BG measured in the first and the second drops of capillary blood samples consecutively obtained from the same site fingertip at an Italian diabetic outpatient clinic. The data were collected in 2013 after obtaining authorization from the Hospital Internal Review Board. The BG data from the first and the second drops from the same subject have been compared, thus reducing the effects of potential confounding factors.[18]

The hypotheses were as follows:

1.There is no difference between the repeated measurements (first and second) obtained for a single subject.