

Does Site Matter? Comparing Accuracy and Patient Comfort of Blood Glucose Samples Taken From the Finger and Palm of the Perioperative Patient

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Purpose: *This study compared two blood glucose (BG) point of care sampling methods to determine which is least painful yet accurate.*

Design: *The two-period, two-treatment crossover trial compared the traditional fingertip sampling method to a form of alternative site testing (AST), palm of the hand.*

Methods: *Subjects received both methods of BG sampling to compare comfort and accuracy. They were randomly assigned to determine which method was used first. Pain rating (0 to 10) and glucose results for both methods were documented.*

Finding: *Results indicated that pain rating was significantly lower with AST (1.65) than with the standard site (2.83) ($P < .001$). There was no significant difference in mean glucose measurements between standard care (150 mg/dL) and AST (149 mg/dL). The numbers were closely correlated ($r = 0.9815$).*

Conclusions: *Findings support AST via the palm of the hand as an accurate and less painful method of obtaining BG results on diabetic patients.*

Keywords: *alternative site testing, glucose, comfort, accuracy.*

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Conflict of interest: None to report.

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ACCORDING TO THE AMERICAN Diabetes Association, 9.3% of the population in the United States has diabetes.¹ The daily management of diabetes requires frequent capillary blood sampling to determine glucose levels and direct diet, exercise, and medication interventions. The complexities of managing nothing by mouth status and the stability of blood glucose (BG) intensifies in the perioperative setting where variations from the normal range leading to hypoglycemia and hyperglycemia can contribute to increased morbidity and mortality.²⁻⁴ Frequently assessing capillary BG levels in this setting allows for stabilization of values and reduces the likelihood of dangerous fluctuations in the patient's condition.

Obtaining capillary BG samples via finger stick is a standard practice in most clinical settings. Yet, eliciting a sample of blood from fingertip can be painful because of the dense nerve fibers positioned in fingertip pads. Some patients use alternative sites to test BG level with reports of less pain.⁵⁻⁸ The most commonly reported alternative site test involves the hand or palm where blood circulation is equivalent to the finger and the nerve fibers are less condensed than the fingertip.⁹

Literature Review

Over the past several years the literature and clinical experiences have pointed to the use of alternative site testing (AST) as a viable option to the traditional finger stick approach of BG sampling. Alternative sites such as ear lobes, forearms, and palms have been noted. However, there is a paucity of research to clearly support the practice. Moreover, researchers exploring the implications of using AST as a method of glucose monitoring note varying results.^{5-8,10} In a study performed by Clarke et al,⁵ traditional finger stick BG sampling was compared with the AST strategy. The results indicated a statistically significant improvement in both pain and ease of performing the procedure when the AST method was used.⁵ Yum and Roe⁶ reported similar findings when they stated that AST was relatively easy to perform method with the added benefit of decreased pain, thus the potential of increasing compliance with glucose testing. Kempe et al⁷ demonstrated similar results in terms of the reliability of the glucose values. The researchers compared the capillary BG values from finger stick samples with those obtained

from the palm and noted similar BG ranges.⁷ The same year, Peled⁸ published a report referencing glucose monitoring with AST as a frequent practice preferred by many patients. Moreover, Peled provided key details on the situations in which the accuracy of AST was dependable.⁸

Peled recognized variability of AST results under conditions of fluctuating glucose levels and provided cautionary recommendations that the AST method be confined to situations in which stable levels could be anticipated.⁸ Despite the agreement of the benefits in terms of patient comfort, Peled clearly recommends reliance on standard finger stick strategies during conditions of patient vulnerability to obtain the most accurate reading possible.⁸ Contrary to the unanimous conclusions of previous researchers that point to decreased pain with AST methods, in 2010, Jacoby published a study reporting that patients did not experience an appreciable benefit with AST but did plan to use it in the future.¹⁰ Thus, additional studies are needed to fully define the settings in which AST can be safely and accurately used to benefit the patient without compromising integrity of the glucose value.

Purpose

The purpose of this study was to compare two methods of obtaining point of care BG samples in the preoperative setting to determine which method was less painful. The clinical nurse researchers hypothesized that patients would experience less pain with BG samples from the alternative site (the palm) when compared with the standard method (finger stick). In addition to comparing pain levels between the finger stick and alternate site, the accuracy of the glucose result between sites was also examined. Therefore, it was also hypothesized that a secondary analysis would demonstrate that glucose values between standard testing and AST do not differ significantly.

Design

The study was designed as a two-period, two-treatment crossover trial. The setting was a 23-bed surgical admission unit, serving 30 operating rooms in addition to several offsite anesthesia procedural areas (ie, magnetic resonance imaging, interventional radiology, and neuroradiology) at an academic medical center. Clinicians practicing in

the unit performed point of care BG testing via finger stick method as standard practice. AST was not current practice in the unit.

Methods

The study was designed as a two-period, two-treatment crossover trial. After obtaining institutional review board approval, potential subjects were screened to determine eligibility according to inclusion and exclusion criteria using a brief review of the electronic medical record. Subjects were included if they were admitted to the preanesthesia setting through the presurgery unit as ambulatory, presurgical/preprocedural patients. Inclusion also required subjects to be an adult aged 18 years or older, English speaking, and a pre-existing diabetic (type 1 or 2). Subjects were excluded if any of the following conditions applied: upper extremity amputation, known peripheral neuropathy or any decreased sensation to hands, prior lymph node surgery to upper extremity, neutropenia/immunosuppression, currently performing AST or previous experience with AST, pregnant, incarcerated, cognitively impaired, inability to use the Pain Analog Scale (PAS), or experiencing impaired coagulation. With the exception of prior AST experience and use of PAS, all inclusion and exclusion criteria were obtained before verbal consent.

After screening and consenting, subjects were randomized into one of two study arms using a computer generated randomization scheme. One group of subjects received the finger stick standard of care capillary BG testing, followed by the AST in the palmar area of the hand, underneath the fifth digit (Figure 1). The other group of subjects received the AST for capillary BG using the palmar area of the hand, underneath the fifth digit before the standard finger stick BG testing. All BG samples were taken from the subject's dominant hand. All BG samples required one small drop of blood from patient as per point of care testing device manufacturer recommendations.¹¹ All subjects received both types of glucose testing and provided information regarding pain scores for both procedures. Less than 5 minutes lapsed as the two glucose samples were acquired and tested. Glucose values and pain scores were recorded for study purposes. However, all patient care was provided based solely on the finger stick standard of care BG results.

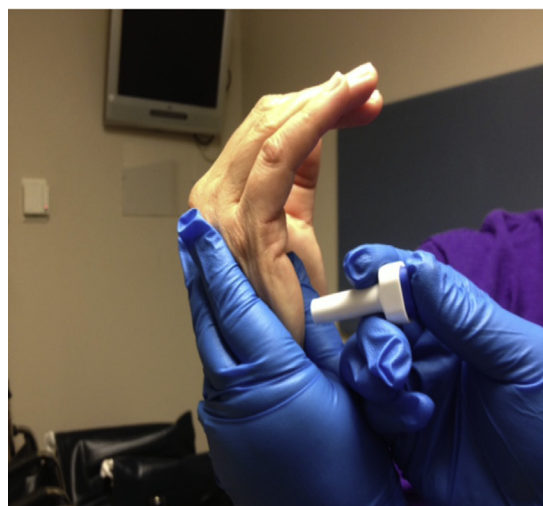
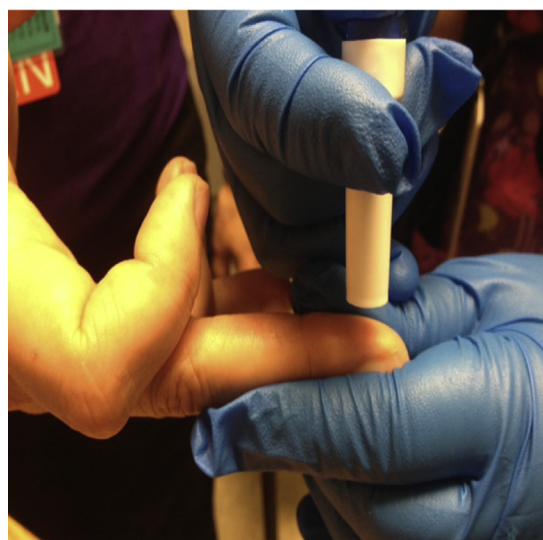


Figure 1. Standard: Finger stick method. Intervention: AST using the palmar area of the hand underneath the fifth digit. AST, alternative site testing. This figure is available in color online at www.jopan.org.

The primary variable of interest was pain. Pain was assessed using the institutional Pain Analog Scale (PAS; 0 to 10 rating). Subjects were asked to rate their level of pain from 0 (no pain) to 10 (the most pain ever experienced) with both methods of obtaining BG samples. In addition, the subjects were also asked to compare their overall experience with AST from the options of “same as,” “better than,” or “worse than” finger stick method. The glucose results from both sites were also measured and compared.

Table 1. Demographic Data*

	N (%)
Gender	
Male	39 (49%)
Female	42 (59%)
Type of diabetes	
Type 1	14 (18%)
Type 2	66 (82%)
Blood glucose history	
Yes	50 (62%)
No	31 (38%)
Frequency	
Not regularly	24 (30%)
Daily	43 (53%)
Weekly	11 (14%)
Monthly or more	3 (4%)
Site	
Dominant	8 (12%)
Nondominant	44 (64%)
Both	17 (25%)
Rotation	
Yes	38 (60%)
No	25 (40%)

*Some data cells contained missing data, thus the sum is not 81 in every category.

Findings

At least 70 subjects were needed to obtain 80% power using a one-sided level of significance of 5%, when the mean difference in pain measurements on a 0 to 10 scale is 0.60. The sample size also accounted for an estimated percent agreement with a standard error of 2.6 percentage points or a margin of error of 5%, thus providing sufficient precision in estimating agreement of BG levels.

Descriptive statistics were computed on all variables of interest. The end points of the PAS and the capillary BG measurements were examined using analysis of variance. Subsequent analyses of the data were performed using an analysis of covariance to estimate the effects of the standard fingertip testing versus the AST, adjusting for baseline patient characteristics.

Results

Data were collected on 84 subjects. However, three of the 84 subjects were not randomized, and therefore data were analyzed on 81 subjects. Of the 81 subjects, 39 were randomly assigned to

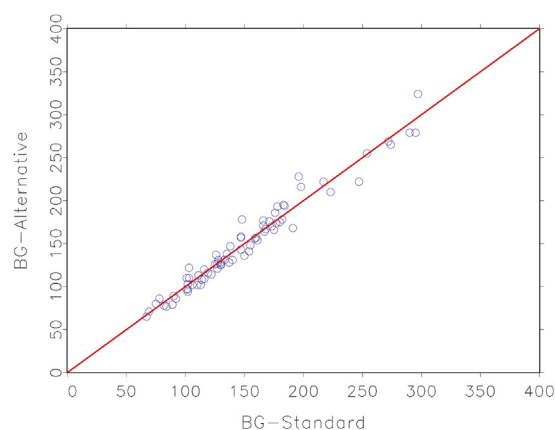


Figure 2. Scatterplot demonstrates the alignment of standard finger stick and AST testing results along the 45° line. The plots suggest that the measurements do not differ between the standard and AST. AST, alternative site testing; BG, blood glucose. This figure is available in color online at www.jopan.org.

obtain the standard site testing first, followed by the AST, and 42 were randomized to receive the AST first, then the standard site. A similar number of female (51%) and male (49%) subjects were studied, and the mean age was 61 years. Type 1 diabetics represented 18% of the subjects and type 2 diabetics accounted for most at 82%. Sixty-two percent of the subjects reported regularly obtaining a capillary BG level for testing with 53% citing that they test daily. The nondominant hand was the preferred site of testing for most subjects (64%), and most subjects note that they regularly rotate the testing site (60%) (Table 1).

Analyses of the primary end points, PAS, and the BG measurement were done using analysis of variance, as described in Jones and Kenward.¹² Subsequent analyses used an analysis of covariance to estimate the effects of the standard versus the alternative site, adjusting for baseline patient characteristics. A statistically significant difference was identified between the methods using the PAS. The mean score of 2.83 for standard finger stick BG testing method was statistically higher than the mean PAS of 1.65 for AST ($P < .001$). In addition, 87% of subjects stated that overall experience with AST was better than or same as when compared with the finger stick method.

The mean capillary BG values were similar between the two test methods. The mean value for

standard testing was 150 mg/dL compared with 149 mg/dL with AST. There was no significant statistical difference in glucose measurements between standard care and intervention (correlation = 0.9815; R^2 = 0.9633; 95% confidence interval, -2.1, 2.8), indicating accuracy between glucose standing testing and AST values (Figure 2).

Discussion

The hypothesis that AST BG sampling for point of care BG testing would be less painful than the standard finger stick method was supported. The findings demonstrate that there was statistically less pain associated with the AST site than the standard site. The secondary hypothesis was also supported and the results from AST were accurate and did not differ significantly from the standard practice site. These results bolster the findings of several previous researchers while providing additional data to support AST as less painful and accurate method of obtaining glucose levels in controlled settings.⁵⁻⁸

A limitation of this study was the number of data collectors. Six different clinicians collected data for this study. Although, all data collectors received

clear and detailed training inclusive of the use of visual aides to increase inter-rater reliability, the number of data collectors reduces the likelihood of precision. In fact, despite all clinicians undergoing instruction and using the same data collection tool, incomplete data were noted on some of the data collection tools. Additional studies should consider decreasing the number of clinicians involved in the data collection process to control variability and increase accuracy of data documentation.

Conclusions

The findings of this study support AST as an accurate and less painful method of obtaining BG results on diabetic patients. This is particularly beneficial in the preoperative setting when patient and family anxieties are often high. Using a more comfortable approach to obtaining patient BG levels is one strategy among many that may create a more comforting experience for the patient and family. Additional studies of this topic will help determine if these findings may be generalized to any practice setting where point of care testing for BG is performed, and if a new standard of sampling practice can be introduced across the continuum of care.

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