Comparison of Capillary and Venous Glucose in Diabetic Patient in a Peripheral Hospital

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ABSTRACT

Introduction: This study was done to determine the mean difference and correlation between fasting capillary and venous glucose estimation.

Methods: This was cross-sectional analytic study done in United Mission Hospital, Palpa, Tansen. Calculated sample size was 92, convenience sampling technique was used. During 5 month of duration in 92 diabetic patients, where fasting capillary and venous glucose were performed consecutively. Confounding was ruled out with matching approach, adjustment tests were also used like X^2 Mantel -Haenszel and logistic regression. Reporting guideline of this observational study was done with the help of SROBE guidelines.

Results: The mean venous blood glucose was 9.52% higher than the Mean capillary glucose. A strong correlation was observed between venous and capillary blood glucose, with Pearson correlation coefficient of 0.94.

Conclusions: There is a significant difference in the blood glucose results analyzed on a bedside glucometer when the samples are taken from capillary or venous sources. Although good correlation is between venous and capillary derived samples, caution must be exercised in accepting the results as equivalent or using either as substitutes for a laboratory blood glucose result.

Keywords: *capillary blood glucose; venous blood glucose.*

INTRODUCTION

According to the latest WHO data published in April 2011 Diabetes Mellitus deaths in Nepal reached 3224, 2.17% of total death and the figure is expected to increase to 366 million in 2030 worldwide.[1-2] The Nepal Diabetic Association reported that the diabetes affects approximately 15% of the people over 20 years and 19% of the people over 40 years of the age in the urban areas of Nepal.[3]

In addition, there have been many concern raised about the accuracy of capillary blood glucose estimation in the face of systemic illness, and it has been suggested that in such patients, venous sampling may be more accurate.[4] Many studies have concluded that glucometers should not be used for diagnosis, only for self-monitoring.[5] In the present study, ascorbic acid, uric acid, a maltose, aspirin, icodextrin and acetaminophen cause around 11% difference in glucose levels.[6]

The objective of this study is to compare capillary and venous blood glucose in diabetic population.

METHODS

A cross-sectional analytic study was conducted to compare difference between capillary and venous blood glucose. United Mission Hospital was selected as the study area for the research. Data collection was done form July to December 2014. All patient attending diabetic clinic and emergency department who were in fasting state were selected as the study population. Approval from the Institutional Review Board was

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taken.

$$n = \frac{2*sd^2*(Z_1-\alpha/2 + Z_1-\beta)^2}{(M1-M2)^2}$$

n= Sample size,

Z1-α/2 = Z value for the required alpha error (1.96 for alpha error of 0.05)

Z1-β = = Z value for the required beta error (0.84 for beta error of 0.20 ~ power of 80%)

sd = standard deviation of the measure (39.1)

M1 & M2 = Mean values in the 2 groups (16.3)

Total sample size = 92

Convenience sampling method was used for the study.

Hypothesis: There will be strong correlation between capillary and venous blood glucose.

Null hypothesis: There will be poor correlation between capillary and venous blood glucose.

Inclusion Criteria

Age above 14, diagnosed case of diabetes mellitus and patient who are ordered for for fasting blood glucose were included in this study.

Exclusion Criteria

Patient who are in terminally ill, under peritoneal dialosis and who have other endocrinology problems were excluded.

All the collected data were examined, compiled, organized and analyzed. Descriptive statistical method was used to analyze and interpret data. Confounding was ruled out with matching approach, adjustment tests were also used like X^2 Mantel -Haenszel and logistic regression. Reporting guideline of this observational study was done with the help of SROBE guidelines. All analyzed data were shown in various table by using SPSS software ver.16.

RESULTS

Male and female were almost equally included in this study. More than half of the study population was more than 65 years of age (58.70%). Three fourth participants of this study were diabetic since less than 10 years (77.20%).

A strong correlation was observed between venous and capillary blood glucose, with Pearson correlation coefficient of 0.94 (Table 1).

Table 1. Relationship between mean capillary and venous glucose.

	Minimum	Maximum	Mean
Capillary Glucose	43	519	168.25
Venous Glucose	67	546	185.53

Mean capillary glucose in male and female was 13.94% and 3.19% lower than venous blood glucose respectively.

Table 2. Relationship of capillary blood glucose and venous blood glucose difference with age.

	age group	n	Mean
Capillary Glucose	≤ 65	38	169.32
	≥ 65	54	167.50
Venous Glucose	≤ 65	38	184.66
	≥ 65	54	186.15

Mean capillary glucose in elderly patients (>65 years) was 10.01% lower than venous

blood glucose while in <65 years' age group capillary blood glucose was 8.30% lower.

Table 3. Relationship of capillary blood glucose and venous blood glucose difference with diabetic duration.

	DM since group	n	Mean
Capillary Glucose	≤ 10 years	71	166.70
	≥ 10 years	21	173.48
Venous Glucose	≤ 10 years	71	182.96
	≥ 10 years	21	194.24

Capillary blood glucose in patients who were under oral hypoglycemic agents was 8.10% lower and in population who were under insulin was 14.12% lower than the venous blood glucose (Table 4).

Table 4. Relationship of capillary and venous blood glucose with different types of hypoglycemic agents.

	Oral agent	N	Mean
Capillary Glucose	yes	77	162.66
	no	15	196.93
Venous Glucose	yes	77	177.00
	no	15	229.33

DISCUSSION

This study shows that capillary blood glucose underestimates venous blood glucose in fasting condition which was opposite to the study done by Elizabeth et al in pediatric population. This shows that episodes of hyperglycemia may be missed in patients on tight glycemic protocol. Blood glucose measurement from different sites (venous, capillary and arterial) using different fractions of blood (whole blood and plasma) and different methods (glucometer, arterial blood gas analyzer and laboratory venous blood analyzer) provides different results. Furthermore, reduced hematocrit, metabolic acidosis, hypoxia, uric acid, ascorbic acid level, Acetaminophen and aspirin level interfere with the measurement of capillary blood glucose sampling.

Also study shows poor precision of capillary glucose method at higher glucose concentration, in male patient, higher age, long history of diabetes mellitus and in one with insulin therapy.

Chakravarthy and colleagues compared finger stick measurements (Accu-Check Inform) with their laboratory reference standard in 21 hypotensive patients; finger stick measurements were higher than laboratory values by a mean of 20.9 mg/dl (16.9%).7 Atkins and colleagues compared finger stickd (Accu-Check II glucose monitor) with laboratory glucose measurements in 25 severely hypotensive patients; only 36% of patients had finger stick measurements within 20% of the laboratory value.[8] Similarly, Sylvain and colleagues compared finger stick (One Touch II glucose meter, Lifescan) with laboratory glucose in 38 patients (27 receiving vasopressor agents) with "poor tissue perfusion" and found a 30% variance between the two methods with a mean difference of 77 mg/dl.[9]

Although the measurement of glucose is one of the oldest established tests in clinical medicine, it is extremely complex and often only an approximation of the "true" level.[10] Blood glucose levels measured from different sites, using different fractions of blood and different methods provide different results. Glucose measurements can be performed on whole-blood, plasma, and serum, and these may be native or deproteinized or hemolyzed in the case of capillary whole blood. Furthermore, the blood may be arterial, capillary, or venous in origin. Glucose is dissolved only in the aqueous part of the drawn specimen and not in its entire volume. This is the major reason for differing glucose concentration in plasma and whole-blood samples. The glucose concentration is approximately 10% higher when measured in plasma as compared to whole blood. This difference is more marked in patients with higher Hematocrit.[11] A number of glucometers correct for this difference and give results as "plasma equivalent." Other blood glucose strips retain red blood cells through a filtering process and measure glucose content in plasma in their reaction zone (e.g., Accu-Chek Comfort Curve test, Roche Diagnostics).

Even the Yellow Springs Instrument's Blood Glucose analyzer, which is considered the reference gold standard, yields laboratory glucose results dependent on Hct when whole- blood samples are used.[12] Furthermore, if laboratory glucolysis is not inhibited in whole-blood specimens the laboratory glucose levels fall with delays in processing the specimen.[13] The method of glucose measurement used by glucometers in routine clinical use are based on either chromogenic or electrochemical reactions of the three enzymes glucose oxidase, dehydrogenase, and hexokinase. This gives rise to method-based specific interferences such as blood and ambient (altitude) oxygen tension, blood pH, and serum cholesterol and triglycerides levels and interfering drugs (maltose, d-xylose, icodextrin, dopamine, acetaminophen).[14]

CONCLUSIONS

However, this study supports the use, within certain limits, of capillary glucose monitoring, carried out by patients, in a general hospital setting. Strong overall correlation was noted between the bedside glucose measurements carried out on the group of patients and simultaneous laboratory glucose determinations. The reliability of measurements by most patients individually was good, as judged by the coefficients of correlation for their capillary versus laboratory glucose determinations. These significant correlations suggest that, for most patients, the average deviation of their glucose measurements from laboratory glucose values was not sufficiently large enough to cause clinically significant errors in therapeutic decisions.

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CONFLICT OF INTEREST: None.

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