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Original Research Paper

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STUDY ON BLOOD GLUCOSE MEASUREMENT BY POCT VERSUS AUTO ANALYZER

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ABSTRACT

Background: POC testing is a widely-used tool to enable immediate determination of glucose levels in hospitalized patients and facilitate rapid treatment decisions in response to fluctuations in glycaemia. **Objectives of the Study:** to estimate and compare blood glucose levels by POCT test using capillary blood and GOP-POD method by auto analyser using venous blood. **Methodology:** We included a total of 100 subjects, 50 controls and 50 type 2 diabetic subjects. Further cases were divided into two groups those with plasma glucose <200 mg/dL and those with plasma glucose levels > 200 mg/dL. We measured plasma glucose simultaneously using glucometer and venous plasma glucose using auto analyser. **Results:** We observed elevated plasma glucose in capillary blood using glucometer as compared to auto analyser estimated venous plasma glucose. **Discussion and Conclusion:** Blood glucose testing with glucometer is a simple, rapid & cost effective method for glucose monitoring. On the other hand, centralized laboratory glucose testing despite higher operational time and cost burden is still more reliable method for diagnosis and management of the patient. So, readings obtained using glucometers especially at the critical hyperglycemic levels, should be cautiously interpreted and verified with centralized laboratory. Medical professionals should depict diabetic patients the importance of periodic centralized laboratory glucose testing. A further detailed study for comparison of plasma glucose levels using glucometer and GOD-POD method in hypoglycemic patients with a larger sample size is needed.

KEYWORDS : glucometer, capillary blood, venous blood, glucose oxidase-peroxidase method, hyperglycemia and type 2 diabetes mellitus.

INTRODUCTION

Diabetes mellitus is a group of metabolic diseases characterized by elevated blood glucose concentration (hyperglycaemia) resulting from either defects in insulin secretion by the pancreas, insulin action or both [1]. While type-I DM occurs mostly in individuals less than 18 years of age and accounts for only 5–10% diabetics, type-II DM has a common occurrence in people over 40 years of age and accounts for 90–95% of individuals with diabetes [1,2,3]. Diabetes mellitus is a cause of morbidity, disability and mortality worldwide. Diabetic-hyperglycaemia is often marked by polyuria, polydipsia, weight loss and sometimes polyphagia and blurred vision [4]. It has been estimated that the total number of diabetics worldwide will rise from 171 million as at 2000 to 366 million in 2030 with more than 85% of them living in low and middle income countries [5].

Glucose is the major carbohydrate found in the blood and a chief source of energy in human body. The nervous system, including the brain, totally depends on glucose from the surrounding extra cellular fluid (ECF) for energy. The concentration of glucose in the ECF must be maintained within a narrow range. When the concentration falls below a critical level, the nervous tissues lose the primary energy source and are incapable of maintaining normal function. Blood Glucose level monitoring is very important in an intensive care unit especially for diabetic patients [6].

Point-of-care (POC) tests provide analytical information that can be used to make decisions at patients' bedside, as opposed to laboratory tests that must be run at a central laboratory. POC testing is a widely-used tool to enable immediate determination of glucose levels in hospitalized patients and facilitate rapid treatment decisions in response to fluctuations in glycaemia. Accurate POC glucose testing requires attention to various factors before, during, and after performance of tests. These include 1) proper preparation of test sites to avoid preanalytical errors, 2) proper identification of tested patients whose physiological status permits sampled capillary specimens to correlate with central venous blood glucose levels to avoid analytical errors, and 3) proper documentation of the fidelity of meter results with the medical record to avoid post analytical errors.

In most of the hospitals, outpatient clinics, emergency rooms and home self-monitoring blood glucose levels glucometers are used for monitoring blood glucose levels. Glucometer monitoring is more easier, convenient, quicker and cheap method. So, there is a need for establishing the reliability of results of Glucometer as they also have limitations. It is challenging to establish the accuracy of blood glucose level obtained from the glucometer which measures capillary blood sample and not venous sample. American Diabetes Association (ADA) guidelines for diagnosis of DM refers to venous sample [7, 8]. Our study is undertaken to compare the glucose levels in capillary whole blood by glucometer and glucose levels in venous plasma samples by semi auto analyser in all patients attending the outpatient clinics irrespective of their diabetic and non-diabetic status and to establish the accuracy of glucometer blood glucose estimation compared to laboratory Semi auto analyser. We have undertaken this study to estimate and compare the blood glucose levels by glucometer, semi-auto analyser and automated analyser.

METHODOLOGY:

Site:

This present study was conducted at RKDF Medical College, Bhopal, MP from July 2022 to November 2022.

Study population:

we included 50 patients suffering from type 2 diabetes mellitus and 50 healthy controls.

Study design: cross-sectional study.

Sample size: 100 patients, 50 healthy controls and 50 type 2 diabetes mellitus.

Data collection and laboratory investigations:

Blood samples are collected from venous blood from each patient in Sodium fluoride container for measuring blood

glucose using the auto analyser (EM 200) by Glucose Oxidase- Peroxidase method. Simultaneously, one drop of venous blood will be placed on the strip of the Glucometer (ACCU-CHECK ROCHE) by electrochemical sensors method in same patient.

Principle of GOD-POD method:

Glucose oxidase enzyme (GOD) oxidizes the specific substrate beta-D-glucose to gluconic acid and hydrogen peroxide is liberated. Peroxidase enzyme acts on hydrogen peroxide to liberate nascent oxygen (O). Nascent oxygen then couples with 4-amino- antipyrine and phenol to form red quinoneimine dye. The intensity of colour is directly proportional to concentration of glucose in plasma. The intensity of colour is measured colorimetrically at 530 nm and compared with that of a standard treated similarly

Statistical Analysis:

Statistical analysis was done using Microsoft Excel spreadsheet, and statistical package for the social sciences (SPSS) version 20.0 software. The data was analysed and expressed as mean ± standard deviation. Statistical significance was assessed using student t test and the value of p was calculated. A p value <0.05 is considered statistically significant.

RESULTS:

Table 1: Shows the comparison of glucose values estimated by POCT versus Auto analyser in cases and controls

	Glucometer	Auto analyser	p value
Controls (n = 50)	119.7±24.62	91.2±23.45	S
Type 2 diabetic subjects having plasma glucose levels <200 mg/dL (n = 24)	189.6±28.97	161.3±26.65	S
Type 2 diabetic subjects having plasma glucose levels >200 mg/dL (n = 26)	343.2±38.87	278.6±34.87	S

DISCUSSION:

In the present study, we included 50 controls and 50 type 2 diabetic subjects out of which 24 of them had plasma glucose <200 mg/dL and 26 of them had plasma glucose >200 mg/dL. We compared the plasma glucose levels by two different instruments one using capillary blood by POCT testing using glucometer and another using venous blood based on GOD-POD method by auto analyser.

In our study the mean blood glucose estimated by glucometer is higher than mean venous plasma glucose estimation by autoanalyzer but there is significant statistical difference ($p < 0.05$). Patients and doctors need a certain level of trust in the results of glucometers. The findings in our study suggested that at very high glucose readings, glucometer can overestimate glucose results. Our study results coincided well with the studies carried out by Reeves ML et al, Khan et al, Baig et al, Clarke et al [9-12].

The studies mentioned above have also raised the question about the reliability of glucometers especially at extreme values. At these critical hyperglycemic values glucometers show the maximum discrepancies and least correlation with centralized laboratory [13].

Certain preanalytical variables may affect their results. Studies indicate an error of measurement of blood glucose using glucometer by hemodynamic factors like edema, use of vasopressor agents, use of insulin. Fluctuations occur with changes in temperature and humidity. The transport of venous blood sample collected in rural areas or at home is problematic. Accuracy in analysis may be affected if venous blood is not transported and processed in a timely fashion.

Glucometer Potential Interferences:

Environmental Factors: Enzymes denature and become inactive at temperature extremes. So, glucometers utilizing enzymes are susceptible to heat and cold. Glucose oxidase glucometers can give falsely elevated glucose values at high altitudes and low temperatures. So, reagents and detector portion (made up of electronics) should be protected from temperature extremes, humidity and moisture.

Physiological Factors:

Patients with increased hematocrit (e.g., polycythaemia) can give falsely low glucose values, while patients with low hematocrit (e.g. anemia or diabetic pregnant females) can give falsely high glucose values with glucometer. High oxygen tension (patients receiving oxygen therapy) can falsely decrease glucose oxidase glucometer results, while hypoxia can falsely overestimate glucose results. Patients with hypotension (e.g. peripheral circulatory failure and severe dehydration in diabetic ketoacidosis, hyperosmolar non-ketotic coma) may give lower glucose levels with glucometer. Low pH (e.g. diabetic ketoacidosis) can falsely decrease glucometer readings, while high pH elevates glucometer readings. Operational Factors: Approximately 91–97% of overall inaccuracies are due to operational factors. The most common reasons are applying insufficient blood sample to the strip, expired strips, strips exposed to excess moisture or humidity, improper code, dirty meters, improper cleaning of the testing site and hemolysed sample.

CONCLUSION:

Blood glucose testing with glucometer is a simple, rapid & cost effective method for glucose monitoring. On the other hand, centralized laboratory glucose testing despite higher operational time and cost burden is still more reliable method for diagnosis and management of the patient. So, readings obtained using glucometers especially at the critical hyperglycemic levels, should be cautiously interpreted and verified with centralized laboratory. Medical professionals should depict diabetic patients the importance of periodic centralized laboratory glucose testing. A further detailed study for comparison of plasma glucose levels using glucometer and GOD-POD method in hypoglycemic patients with a larger sample size is needed.

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