

A comparative study of blood glucose level measurement between glucometer and semi autoanalyser

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Abstract

Introduction: There is a direct relationship between glycemic control and risk of systemic complications leading to high morbidity and mortality in diabetes.³ Estimation of blood glucose is the main investigation for the diagnosis and management of diabetes mellitus and also for monitoring emergency complications of DM. Glucometers are used for monitoring blood glucose levels in most of the hospitals. There is a need for establishing the reliability of results of glucometer as they also have limitations.⁶ Our study is undertaken to compare the glucose levels in capillary whole blood by glucometer and glucose levels in venous plasma samples by semi autoanalyser.

Materials and Methods: Study was conducted in the department of Biochemistry Osmania General Hospital. 50 Subjects both male and female in the age group of 25 to 65yrs attending out patient department of Medicine at Osmania General Hospital were included in the study. Capillary blood glucose is measured with a glucometer and venous plasma sample glucose is measured with a semi autoanalyser. Statistical analysis is done by mean comparison and student t test.

Results: When the two means are compared there is increase in the blood glucose levels measured by using a glucometer (117.76±39.01) when compared to venous blood samples levels measured by using a semi autoanalyzer (108.78±39.05) but there is no statistical significance (P> 0.05). Results showed a variation of 2% to 15% in individual subjects between the blood glucose levels by two methods.

Conclusion: Mean glucose levels in capillary blood sample estimated by glucometer is higher than the mean glucose levels in venous plasma samples estimated by semi autoanalyser, but there is no statistical significance. Hence glucometer can be used at bedside as a better alternative for out patient department diagnosis and in emergency situations.

Keywords: Glucometer, Semi auto analyser, Blood glucose.

Introduction

Diabetes Mellitus (DM) is the most common metabolic disorder in the world. In western population the prevalence is 5-10%.¹ In developing countries like India, its prevalence is increasing rapidly. According to international diabetes federation 61.3 million people had diabetes in 2011, by 2030 it will rise to 101.2 million.²

There is a direct relationship between glycemic control and risk of systemic complications leading to high morbidity and mortality in diabetes.³ Estimation of blood glucose is the main investigation for the diagnosis and management of diabetes mellitus and also for monitoring emergency complications of DM like diabetic ketoacidosis, hypoglycemia and nonketotic hyperosmolar hyperglycemia.

In most of the hospitals, out patient clinics, emergency rooms and home self monitoring blood glucose levels glucometers are used for monitoring blood glucose levels.^{4,5} 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.⁶ 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

Our study is undertaken to compare the glucose levels in capillary whole blood by glucometer and glucose levels in venous plasma samples by semi autoanalyser in all patients attending the out patient 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.

Materials and Methods

Study was conducted in the department of Biochemistry Osmania General Hospital. 50 Subjects both male and female in the age group of 25 to 65yrs attending out patient department of Medicine at Osmania General Hospital were included in the study. All the patients who were advised for blood glucose estimation were selected and asked to come the next day in 8hrs fasting state. Subjects were selected irrespective of their diabetic status. After due consent taken from the subjects fasting venous sample of 3ml is collected and samples are sent to the biochemistry lab. Plasma glucose is estimated in the samples by Glucose Oxidase Peroxidase (GOD-POD) method by using a Semi autoanalyser. (Transasia).^{8,9} At the same time in all the subjects blood

glucose estimation was done by glucometer (Accucheck) in capillary sample collected by finger prick method.¹⁰

Statistical Analysis

The results were analysed on SPSS statistical software. All estimates were presented as Mean \pm SD and statistical treatment were performed using student t test. P value \leq 0.05 were considered as statistically significant.

Results

Study group includes 50 subjects in the age group of 25 to 65yrs. Venous plasma blood glucose is measured in all the 50 subjects by using semi autoanalyzer and capillary blood glucose is measured in the same subjects at the same time by using glucometer.

The results are recorded in a master chart (Table 1). Blood sugar levels by two methods in each subject are compared and percent difference between the two values are compared (Table 1). Results showed a variation of 2% to 15% in individual subjects between the blood glucose levels by two methods.

Table 1: Comparison of glucose levels estimated by glucometer and semi autoanalyzer

| S. No | Age | Sex | Glucose Measured with Glucometer (mg/dl) | Glucose Measured with Semi Autoanalyzer (mg/dl) | % Difference |
|-------|-----|-----|--|---|--------------|
| 1 | 32 | M | 104 | 90 | 15 |
| 2 | 68 | M | 120 | 117 | 2.5 |
| 3 | 40 | M | 101 | 92 | 9.7 |
| 4 | 60 | F | 86 | 70 | 13 |
| 5 | 40 | F | 112 | 100 | 12 |
| 6 | 25 | F | 95 | 84 | 13 |
| 7 | 33 | M | 162 | 144 | 12.5 |
| 8 | 65 | M | 82 | 76 | 7.8 |
| 9 | 60 | M | 116 | 104 | 11.5 |
| 10 | 45 | F | 93 | 80 | 8.7 |
| 11 | 32 | F | 204 | 200 | 2 |
| 12 | 45 | F | 82 | 80 | 2.5 |
| 13 | 52 | M | 104 | 100 | 4 |
| 14 | 39 | M | 101 | 88 | 14.7 |
| 15 | 50 | F | 84 | 76 | 10.5 |
| 16 | 23 | F | 100 | 92 | 8.6 |
| 17 | 55 | M | 100 | 88 | 13. |
| 18 | 42 | F | 180 | 180 | 0 |
| 19 | 25 | F | 185 | 184 | 0 |
| 20 | 28 | M | 127 | 122 | 4 |
| 21 | 38 | F | 170 | 150 | 13.3 |
| 22 | 25 | F | 107 | 104 | 2.8 |
| 23 | 42 | F | 109 | 100 | 9 |
| 25 | 28 | M | 93 | 88 | 5.6 |
| 26 | 45 | M | 82 | 76 | 7.8 |
| 27 | 60 | M | 89 | 79 | 12.6 |
| 28 | 39 | F | 184 | 166 | 10.8 |
| 29 | 50 | F | 105 | 95 | 10.5 |
| 30 | 50 | M | 95 | 86 | 10.4 |
| 31 | 56 | M | 79 | 70 | 12.8 |
| 32 | 45 | M | 100 | 87 | 13 |
| 33 | 50 | F | 104 | 93 | 11.8 |
| 34 | 65 | M | 224 | 211 | 6.16 |
| 35 | 50 | F | 104 | 91 | 14.2 |
| 36 | 38 | F | 90 | 84 | 7.1 |
| 37 | 35 | M | 240 | 225 | 6.6 |
| 38 | 60 | M | 112 | 100 | 13.04 |
| 39 | 65 | M | 96 | 86 | 11.6 |
| 40 | 64 | M | 100 | 88 | 13.63 |
| 41 | 55 | M | 101 | 101 | 0 |

| | | | | | |
|----|----|---|-----|-----|-------|
| 42 | 34 | M | 125 | 116 | 7.75 |
| 43 | 65 | M | 87 | 78 | 11.53 |
| 44 | 38 | M | 114 | 103 | 10.67 |
| 45 | 54 | M | 98 | 90 | 8.88 |
| 46 | 40 | M | 198 | 192 | 3.12 |
| 47 | 55 | F | 156 | 149 | 4.69 |
| 48 | 55 | M | 102 | 99 | 3.03 |
| 49 | 58 | M | 88 | 87 | 1.14 |
| 50 | 66 | M | 90 | 79 | 13.92 |

The mean plasma venous blood glucose measured by Semi autoanalyzer is 108.78 ± 39.05 and mean capillary blood glucose measured by glucometer is 117.76 ± 39.01 . When the two means are compared there

is increase in the blood glucose levels measured by using a glucometer when compared to venous blood samples levels measured by using a semi autoanalyzer but there is no statistical significance ($P > 0.05$) (Table 2) Fig. 1.

Table 2: Comparison of mean glucose levels measured by two methods

| Method | Sample | Mean blood Glucose | t value | P value |
|-------------------|-----------------|--------------------|---------|-------------------------|
| Glucometer | Capillary blood | 117.76 ± 39.01 | 1.13 | 0.129 (>0.05) NS |
| Semi Autoanalyser | Venous Plasma | 108.78 ± 39.05 | | |

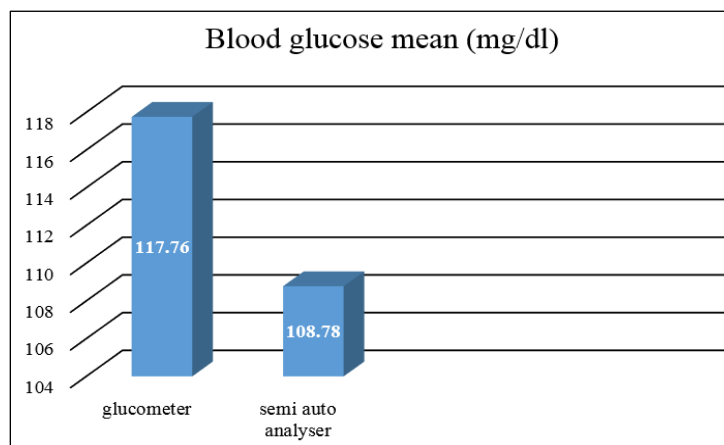


Fig. 1: Comparison of mean blood glucose levels estimated by glucometer and semi autoanalyser

Discussion

In our study the mean blood glucose estimated by glucometer is higher than mean venous plasma glucose estimation by Semi autoanalyzer but there is no statistical significance. Similar outcome was observed in other studies also.^{11,12} Capillary blood glucose is comparable to arterial blood glucose level. Literature indicates a difference of 7% between postprandial arterial blood glucose and post prandial venous blood glucose with venous blood glucose being lower. But not significant difference in fasting samples. This is explained by absorption of glucose by the tissue cells via diffusion in peripheral capillaries and some glucose returns to veins.¹³ So venous plasma glucose level is the estimate glucose after utilization of glucose by tissues, which in turn is dependant on effects of insulin, glucagon, cortisol, postprandial and preprandial status. This explains the lower levels of glucose in venous blood samples in our study when compared to capillary blood glucose levels measured with a glucometer. Statistical

significance is not seen as the samples analysed are fasting samples.

Previous studies regarding the accuracy of blood glucose estimate when comparing glucometer against semi autoanalyser methods are giving different opinions.^{6,14-16} American Diabetes Association has recommended that glucometers agree to within $\pm 15\%$ of the lab method at all concentrations.⁴ In our study the difference in the glucose levels for each subject varied between 2 to 15% which is well within the recommendation of ADA.

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.¹⁶ 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.

In our study though a variation is observed between the blood glucose levels measured by glucometer and

semi autoanalyser there is no statistical significance. Individual subject variation of blood glucose levels showed only a difference of 2 to 15%. So capillary blood glucose measurement using glucometer a portable point of care device is a recommendable alternative to venous plasma glucose sample estimation using a semi auto analyser as it is convenient, easier, and less invasive technique.^{5,15}

Conclusion

Mean glucose levels in capillary blood sample estimated by glucometer is higher than the mean glucose levels in venous plasma samples estimated by semi autoanalyser, but there is no statistical significance. The difference between the two values measured by the two methods in each subject ranged between 2% to 15%. Hence glucometer can be used at bedside as a better alternative for out patient department diagnosis and in emergency situations. Capillary blood glucose done on glucometer is acceptable but it should be confirmed by venous plasma glucose levels for diagnosis and monitoring of diabetes mellitus.

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