Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 6, Issue, 05, pp.6610-6613, May, 2014

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

COMPARISON BETWEEN GLUCOMETER AND CHEMICAL ANALYZER FOR MEASURING BLOOD GLUCOSE OF DIABETIC PATIENTS

***Khartoum Sudan**

Faculty of Medical Laboratory Sciences, Al-Neelain University

ARTICLE INFO

Article History:

Received 08th February, 2014
Received in revised form
04th April, 2014
Accepted 15th April, 2014
Published online 20th May, 2014

Key words:

Diabetes mellitus,
Glucometer,
Chemical analyzer.

ABSTRACT

Background: Diabetes mellitus (DM) is one of the most common non-communicable disease world-wide. As the style of living in Sudan is changing to a more westernized way, with less physical activity and more dependence on carbohydrate and fat-rich diets the incidence of the disease is increasing. The management of the disease requires continuous monitoring of the patient's blood sugar, The two commonly used methods are bedside, home-based glucometers and laboratory-based chemical analyzer. The current study aimed to determine the accuracy of bedside glucometer (ACCU, CHEK) for blood glucose measurement as compared to laboratory-based automated chemical analyzer

Material and Methods: A cross-sectional study included 79 diabetes mellitus patients, 49% males and 51% females, with age ranged from 20-70 years, recruited from Omdurman military hospital during the period between June to December 2012. From which venous blood was collected from each participant in lithium heparin container for measuring blood glucose using the chemical analyzer (Mindray200), simultaneously, one drop of capillary blood was placed on the strip of the glucometer (ACCU check). The data was analyzed using Statistical Package for Social Sciences (SPSS) and the data were expressed as mean ± standard deviation

Result: No statistical significant difference was observed between blood glucose readings using the chemical analyzer (191.5±126.7 SD) and the glucometer (176.6±126.1 SD) with *P.* value 0.460, although glucometer showed lower readings than chemical analyzer.

Conclusion: We concluded that the bedside glucometer was as accurate as laboratory based auto analyzer, and can be used at home to monitor the glucose level.

INTRODUCTION

Diabetes mellitus (DM) is one of the most common non-communicable diseases (NCDs) globally. It is the fourth or fifth leading cause of death in most high-income countries and there is substantial evidence that it is epidemic in many economically developing and newly industrialized countries. (http://www.diabeteshealth.com/read/1992/12/01/48/diabetes-in-sudan) valence of diabetes for all age-groups worldwide was estimated to be 2.8% in 2000 and 4.4% in 2030. The total number of people with diabetes is projected to rise from 171 million in 2000 to 366 million in 2030. The prevalence of diabetes is higher in population in developing countries is projected to double between 2000 and 2030. The most important demographic change to diabetes prevalence across the world appears to be the increase in the people >65 years of age (Wild *et al.,* 2004) Globally, as of 2010, an estimated 285 million people had diabetes, with type 2 making up about 90% of the cases. (Elsevier Saunders) Its incidence is increasing rapidly. Diabetes mellitus occurs throughout the world, but is more common (especially type 2) in the more developed countries. The greatest increase in prevalence is, however, expected to occur in Asia and Africa, where most patients will probably be found by 2030. (Wild *et al.,* 2004) The majority of people in Africa with diabetes is between 45 and 64 year of age. African diabetic patients are to 70-90% type 2 diabetes and 25% type 1 diabetes (Papoz *et al.,* 1998; Elbagir *et al.,* 1998). The prevalence of type 2 DM in the adult population ranges from 0% in Togo to 10.4% in Northern Sudan, and the prevalence of type 1 DM in all ages ranges from 0.3/1000 in Nigeria to0.95/1000 in Sudan. (Motala *et al*., 2003) Type 1 diabetes is rarer in African countries than type 2. (Gill 2000) In Sudan and other African countries the growing wave of urbanization has altered many people's lifestyles. These lifestyle changes include the increased use of motorized vehicles, little or no time devoted to regular exercise, too many sedentary hours watching TV and large amounts of sugar, refined cereals and fat consumed instead of the healthy traditional foods. (Ahmed 2000) Consequently, diabetes is now one of the major health problems in Sudan resulting in 10% of all hospital admissions and mortality. (Ahmed 2000) The actual number of people with diabetes in Sudan is not known. A small

Corresponding author: Khartoum Sudan,
Faculty of Medical Laboratory Sciences, Al-Neelain University

population- based study in 1993 of a sample of 1284 adult men, showed a prevalence of 3.4% of type 2 diabetes. (Elbagir *et al.,* 1996) Diabetes mellitus is a chronic disease which cannot be cured except in very specific situations.

Disease management focuses on keeping blood sugar levels as close to normal ("euglycemia") as possible, without causing hypoglycemia. This can be accomplished with diet, exercise, and use of appropriate medications, such as insulin. Patient education, understanding, and participation is vital, since the complications of diabetes are far less common and less severe in people who have well-managed blood sugar levels. (Nathan 2005; Keith ?) Attention is also paid to other health problems that may accelerate the deleterious effects of diabetes. These include smoking, elevated cholesterol levels, obesity, high blood pressure, and lack of regular exercise. (Dr. Julian Barth *et al*., 2008) Keeping an accurate idea of blood glucose levels is an integral part of successful diabetes management. Individuals with Type 2 DM should be encouraged to perform self-monitoring of blood glucose (SMBG). The frequency of testing depends on the treatment regimen used. A1C levels should be checked every three months. (Jacqueline James and Margaret De Melo 2009) Blood glucose milliliters- allow to do this. Urine testing remains important (to check for the presence of ketones), but having an accurate blood sugar meter makes sense for staying on top of diabetes. Choosing the right meter will depend on the products available, the cost of test strips, NHS prescription availability. The advantage of using glucometer includes an easy to handle interface, quick, low blood volume is used, does not require technical knowledge, and results are obtained swiftly. Most of the benefits for the physicians, nurses, patients and administration are based on the belief that "faster is better" and that more rapid testing at bedside will improve medical care and decrease utilization of hospital resources. (Ellis Jacob 1996) The aim of the current study was to determine the accuracy of using the bedside glucometer (ACCU, CHEK) for blood glucose measurement as compared to laboratory- automated chemical analyzer.

MATERIALS AND METHODS

In a cross-sectional study a sample of 79 diabetes mellitus patients, 49% males and 51% females, with age ranged from 20-70 years, recruited from Omdurman military hospital during the period between June to December 2012. The demographic data collected using structural interviewing questionnaire included age, gender, and marital status. The study was approved by the ethical committee of faculty of medical laboratory science, Al-neelain University, and informed consent was obtained from each participant. Two ml of venous blood was collected from each participant in lithium heparin container for measuring blood glucose using the chemical analyzer (Mindray200), simultaneously, one drop of capillary blood was placed on the strip of the glucometer (ACCU check). Blood glucose was measure instantaneously from both specimens. The data was analyzed using Statistical Package for Social Sciences (SPSS) and the data were expressed as mean ± standard deviation The comparison of the mean values within the group was done using independent t-test and the differences were considered statistically significant if $P < 0.05$.

RESULT

The blood glucose of the 79 diabetes patients enrolled in the present study was determined simultaneously with glucometer (ACCU check) and an automated analyzer (mindray200) in the clinical laboratory of Omdurman military hospital, and no statistical significant difference was observed between blood glucose readings using the chemical analyzer (191.5±126.7 SD) and the glucometer (176.6±126.1 SD) with *P.* value 0.460, although glucometer showed lower readings. When the blood glucose level was assessed according to the gender of the patient the blood level of glucose present study showed no statistically significant difference between that of males using the chemical analyzer (217.6±158.4SD), when compared with glucometer (202.8±158.4SD) with *P.* value 0.674. The results of female patients also showed no statistically significant difference in glucose level when measure with the chemical analyzer (163.3±69.6SD), as compared to the results of glucometer (148.42±69.2SD) with *P.* value 0.350. Based on the marital status of the patient, no statistically significant difference was observed between the readings of blood glucose of single patients with the chemical analyzer (220.29±114SD) as compared to the glucometer (205.2±.647SD) with *P.* value 0.647, similar results were also obtained for married patients with chemical analyzer (179.02±130.8SD) and the glucometer (164.20±130.4SD) with *P.* value 0.647. The methods were also assessed based on the age of the diabetes patient, and it was found that no statistically significant difference in the readings of blood glucose among patients aged less than 30 year measured by chemical analyzer (171.4±104.7) as compared to glucometer (156.61±03.8) with *P.* value 0.503. On the other hand similar results were obtained among patients aged 30 years and more estimated with chemical analyzer (218.21±148.4) as compared to glucometer (203.15±148.) with *P.* value 0.677.

Table 1. Mean and SD of glucose measured by glucometer and auto-analyzer

Procedure		N	Mean	Std. Deviation	p.value
Glucose mg/dl	Glucometer	79	176.66	126.104	
	Auto-analyzer	79	191.56	126.729	.460

Table 2. Mean and SD of glucose measured by glucometer and auto-analyzer according to gender

Procedure		N	Mean	Std. Dev.	P. value
Male Glucose mg/dl	Glucometer	41	202.83	158.471	.674.
	Auto-analyzer		217.66	159.314	.674
Female Glucose mg/dl	Glucometer	38	148.42	69.255	.350
	Auto-analyzer		163.39	69.627	

Table 5. Mean and SD of glucose measure by glucometer and auto-analyzer according to marital status

Procedure		N	Mean	Std. Dev.	P. value
Single	Glucometer	24	205.21	112.831	.674
Glucose mg/dl	Auto-analyzer		220.29	114.014	.647
Married	Glucometer	55	164.20	130.488	.553
Glucose mg/dl	Auto-analyzer		179.02	130.898	

Table 6. Mean and SD of glucose measure by glucometer and auto-analyzer according to age

Procedure		N	Mean	Std. Dev.	P. value
Less than 30y Glucose mg/dl	Glucometer	45	156.64	103.890	
	Auto-analyzer		171.42	104.731	.503
30y and more Glucose mg/dl	Glucometer	34	203.15	148.077	.677
	Auto-analyzer		218.21	148.496	

DISCUSSION

Diabetes is a chronic carbohydrate metabolism disorder that require continuous blood glucose monitoring. The two common methods used for blood glucose measurement are the bedside glucometer, and laboratory-based chemical analyzer, each of these methods has its advantages and disadvantages. The most important aspect of these methods is their accuracy in determining the exact blood glucose level. The present study is an attempt to explore any difference in the readings obtained from both methods. The results showed lower levels of blood glucose when measured with the bedside glucometer as compared to that of the chemical analyzer, although this difference did not reach the point of statistical significance, which agree with the findings of a study carried out by Grünert C, Wood WG (Grünert 1995) who compared Bayer ELITE glucometer and the laboratory-based enzymatic, although the two glucometers used in the current and the previous study are different but the principle behind both remains the same. This fact makes the findings of the above study comparable to the results of our study. The small difference seen between both methods can be attributed to the amount of blood used for measuring the glucose level, and it is also known that readings of most glucometers fluctuate with changes in temperature and humidity. (Sacks *et al.*, 2002) The gender of the patient showed no influence over the blood glucose readings by both methods, although glucometer showed lower readings, but neither statistically nor clinically significant in both male and female patients. on the other hand this study also showed no difference in measurement of males glucose by tow methods.which disagree with the findings of study carried out by Ayaz Baig, Imran Siddiqui, Abdul Jabbar, Syed Iqbal Azam, Salman Sabir, Shahryar Alam, Farooq Ghani. (Ayaz Baig *et al.*, 2007) Who showed that very low and high glucose values with glucometer do not accurately reflect actual plasma glucose levels. This disagreement may be due to the difference in glucometers used in both studies, and the level of blood glucose of the cases in both previous studies was either extremely high or low which make the difference between the two methods highly resolved. The current study also showed no significant difference between the results of the two methods when the blood glucose of single patient patients and married patients.

Conclusion

We conclude that the bedside (glucometer) method as accurate as laboratory based auto analyzer method, and can be used at home to monitor the glucose level.

REFERENCES

Ahmed AM, Ahmed NH. Hospitalization patterns of diabetic patients in Sudan. *Diabetes Int.*2000; 10: 18–19.

Ayaz Baig, Imran Siddiqui, Abdul Jabbar, Syed Iqbal Azam, Salman Sabir, Shahryar Alam, Farooq Ghani. Comparison between bed side testing of blood by glucometer Vs centerlized testing in a tertiary care hospital *J Ayub Med Coll Abbottabad* 2007; 19(3).

Diabetes and impaired glucose tolerance International Diabetes Federation. http://www.diabeteshealth.com/read/1992/12/01/48/diabetes-in-sudan. Accessed on 15/12/2012

Dr Julian Barth, Dr Indranil Dasgupta, Dr Michael Feher, Natasha Jacques, Dr Eric Kilpatrick. Dr Ian Lawrence National Institute for Health and Clinical Excellence 27, The management of type 2 diabetes. *Clinical guideline 66: Type 2Diabetes*. London may 2008 *diabetes*

Elbagir MN, Eltom MA, Berne C. Classification of newly-onset IDDIM and NIDDIM in subjects aged 25-45 years in Sudan. *J Intern Med*. 1998 Dec; 244(6):443-50.

Elbagir MN, Eltom MA, Elmahdi EMA, Berne C. A population based study of the prevalence of diabetes and impaired glucose tolerance in adults in northern Sudan. *Diabetes Care* 1996; 1126-1128.

Ellis Jacob. Point of care (near-patient) testing. Kaplan LA, Pesce AJ, Kazmierezak SC. Clinical Chemistry 3rded: New York: Mosby; 1996.p.313-22.

Elsevier Saunders. *Williams textbook of endocrinology* (12th ed.). Philadelphia: pp. 1371–1435. ISBN 978-1-4377-0324-5.

Gill G. Good bye 'IDDM' – hello 'Type 1'.*Diabetes Int*. 2000; 10: 34. InSudan and other African countries the growing wave of urbanization has

Grünert C, Wood WG Comparison between the Bayer ELITE glucometer and the hexokinase method for glucose determination on the Eppendorf EPOS 5060 using capillary whole blood sample *Eur J Clin ChemClinBiochem*. 1995Mar;33(3):153-6.

Jacqueline James, Margaret De Melo, Diabetes Care and Education Committee Banting and Best Diabetes Centre Faculty of Medicine, University of Toronto 7th Edition © 2009

Keith E. Davis, Mike Wolfe, Megan Williams, Reena Josoff The effect of intensive diabetes therapy on the development and progression of neuropathy. *Shoshone Family Medical Center's Southern Idaho Diabetes Education Program has been Recognized by the American Diabetes Association for Quality Self-Management Education.*, 561–8. doi:10.1059/0003-4819-122-8-199504150-00001. PMID7887548.

Motala AA, Omar MA, Pirie FJ. Diabetes in Africa. Epidemiology of type 1 and type 2 diabetes in Africa. *J Cardiovasc Risk*. 2003;10(2):77-83.

Nathan DM, Cleary PA, Backlund JY, Genuth SM, Lachin JM, Orchard TJ, Raskin P, Zinman B; Diabetes Control and Complications Trial/ Epidemiology of Diabetes Interventions and Complications (DCCT/EDIC) Study Research Group (December 2005). *The New England Journal of Medicine* 353 (25): 2643–53

Papoz L, Delcourt C, Ponton-Sanchez A, Lokrou A, Darrack R, Toure IA, Cuisinier-Raynal JC. Clinical classification of diabetes in tropical West Africa. Diabetes Res Clin Pract. 1998; 39(3):219-27.

Sacks DB, Bruns DE, Goldstein DE, Maclaren NK, McDonald JM, Parrott M. Guidelines and recommendations for

laboratory analysis in the diagnosis and management of diabetes mellitus. *Clin Chem* 2002; 48(3):436-72.

Wild S, Roglic G, Green A, Sicree R, King H. 2004. "Global prevalence of diabetes: Estimates for the year 2000 and projections for 2030". *Diabetes Care* 27 (5): 1047–53. doi:10.2337/diacare.27.5.1047. PMID 15111519.

****