A Review on the Clinical Impact of Point of Care Capillary Blood Glucose Measurement in Diabetes Patients in Public Primary Care Clinics in Hong Kong

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In the public primary care clinics in Hong Kong, almost all diabetic patients would have routine POC capillary blood glucose measured with a validated glucometer by trained health care assistants during follow up before doctor consultations. These POC capillary blood glucose tests would be done at any time irrespective of the time of their last oral intake. Therefore, under some situations, e.g. a patient with high POC capillary blood glucose shortly after a meal, the POC capillary blood glucose results might have little clinical implication. On the other hand, the POC capillary blood glucose results might reveal instant hyper- or hypo-glycaemic state of patients so that prompt management could be provided.

Although the routine practice of POC capillary blood glucose measurement had been used in our out-patient settings for many years, there was no recommendation by international guideline about the clinical application of the test. With the aging population and increasing prevalence of diabetic patients, the increasing workload of POC capillary blood glucose measurement has become a stress to our public primary care service. Therefore question has been raised about whether it is evidence-based and clinically indicated to continue our usual practice of POC capillary blood glucose measurement for every diabetic patient in the primary care out-patient clinic setting. This study was therefore designed to answer the research question of "Is there any clinical implication to continue our usual practice of POC capillary blood glucose measurement in out-patient diabetic patients?" with the objectives stated below.

Objectives

To evaluate the clinical impact on the use of POC capillary blood glucose measurement in terms of the proportion of patients with hypo or hyper-glycaemic readings and to evaluate the risk factors for those patients with abnormal POC capillary blood glucose readings.

Methodology

Study design

This is a retrospective review study to investigate the clinical impact of POC capillary blood glucose measurement in diabetic patients in two of the public primary care clinics in a local district in Hong Kong. The two participated clinics served approximately 6000 diabetes patients in 2014. Bayer glucometers were used in the clinics and the accuracy of the glucometer was validated by trained health care assistant daily by control solution in both hyperglycaemic and hypoglycaemic ranges.

A list of patients coded for diabetes mellitus by International Classification of Primary Care (ICPC) (T89: Diabetes insulin dependent, T90: Diabetes non-insulin dependent) who had been seen in the clinics between 1 May 2014 to 31 August 2014 was generated from the Hong Kong Hospital Authority Clinical Data Analysis and Reporting System (CDARS). All patients attended for regular follow-up for diabetes during the above period in the participating clinics would be included. The 4 month period would be able to include all the diabetic patients as the longest follow up duration was 16 weeks. The patients' information and the clinical consultation notes in the past 1 year would be reviewed in the computerised Clinical Management System and the relevant data would be retrieved for further data analysis.

Procedure

Demographic and biochemical data including age, sex, duration of diabetes and latest HbA1c level were documented. Other factors that might be associated with abnormal POC capillary blood glucose readings would be evaluated and these included reported hypoglycaemic episodes within past one year, number of oral anti-diabetic drugs taking, use of sulphonylurea and use of insulin. The practice of SMBG with its readings was also evaluated. The POC capillary blood glucose readings during follow up would be reviewed. The readings would be further categorized into at fasting, less than 2 hours post-prandial and 2 hours or more post-prandial for analysis.

Optimal diabetes control was defined as latest HbA1c level within the range of 6 to 7% [4]. Hypoglycaemic range of capillary blood glucose level was defined as value less than 4 mmol/L while hyperglycaemia with risk of Diabetic Ketoacidosis (DKA) or Hyperosmolar Hyperglycaemic State (HHS) was defined as capillary blood glucose level greater than or equal to 14 mmol/L since the diagnosis of diabetic ketoacidosis requires the patient's plasma glucose concentration to be above 13.9 mmol/L. Abnormal POC capillary blood glucose readings were defined as either hypoglycaemic or hyperglycaemic readings with risk of DKA or HHS as stated above, or capillary blood glucose levels greater than 6 mmol/L at fasting or greater than 8 mmol/L at 2 hours or more post-prandial.

Sample size calculation

There were approximately 220,000 patients with diabetes mellitus being followed up in all public primary care clinics in Hong Kong during the study period. A sample size of 784 patients would be able to achieve 95% confidence interval, 80% power with 5% margin of error [15].

Sampling method

Simple random sampling of all diabetes patients with follow-up attendances at the two participating clinics during the study period was used.

Outcomes

Primary outcome was the proportion of patients with hypo- or hyper-glycaemic POC capillary blood glucose readings and the secondary outcome was to evaluate the risk factors for patients with abnormal readings.

Statistical analysis

All statistical analyses were conducted with IBM SPSS version 21.0. Proportions were presented by percentages. Continuous data with normal distribution were presented by mean with standard deviations. Differences were considered statistically significant when $p<0.05$. Risk factors for patients with abnormal clinic capillary blood glucose readings were evaluated by logistic regression.

Results

Study population

A list of 5962 diabetes patients was retrieved during the study period with 784 patients included after randomisation. A total number of 2741 consultations were conducted during the study period. The

Detects discrepancy between POC capillary blood glucose levels and SMBG/ HbA1c results

POC capillary blood glucose levels can be used to compare with SMBG readings to detect inaccurate SMBG readings if there are discordant results. A persistently high POC capillary blood glucose level in contrast with an optimal HbA1c result may also provide evidence of inaccuracy of HbA1c level. Clinical conditions that may affect the erythrocyte turnover such as haemolysis, blood loss, etc. would then need to be considered [4].

Detects hypo- or hyperglycaemic ranges

Very high POC capillary blood glucose levels may detect patients at risk of acute hyperglycaemic complications such as DKA or HHS. POC capillary blood glucose levels in hypoglycaemic range in asymptomatic especially elderly patients would prompt the physicians on further enquires about the underlying reasons of hypoglycaemia and adjustment of anti-diabetic drugs if indicated.

Male patients, patients on more oral anti-diabetic drugs, patients on insulin, patients without practice of SMBG and patients with suboptimal latest HbA1c level were more likely to have abnormal POC capillary blood glucose readings according to our study. If resources are not allowed, POC capillary blood glucose measurement could be selectively performed in these diabetes patients with associated risk factors.

Limitations

We acknowledge some limitations in our study. Firstly, some consultations were excluded due to missing data on POC capillary blood glucose readings. Secondly, some information obtained from patients such as the SMBG results and time of meals taken might not be accurate due to recall bias. Thirdly, the subjects in this study were recruited from two public primary care clinics in a local district which limits the generalisability of our results to the whole local population.

Conclusion

POC capillary blood glucose measurement is a simple clinic test that can provide physicians with an important clinical parameter in addition to the HbA1c level for a more timely diabetes management. With the increasing load of diabetes patients, it might not be feasible or practical to perform POC capillary blood glucose measurement in all diabetic patients on follow up. However, it should still be performed in selected patients with the risk factors for abnormal POC capillary blood glucose readings.

Declaration

Ethical approval

Approved by the Research Ethics Committee for Hong Kong Hospital Authority Kowloon Central and Kowloon East Clusters (KC/KE-14-0203/ER-3).

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Conflict of interest

None.

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