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Brief report

Deciding between using the first or second drop of blood for the self monitoring of blood glucose

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ABSTRACT

Aims: To explore whether the first or the second drop of blood is more suitable for the self-monitoring of blood glucose (SMBG).
Methods: SMBG was employed in hospitalized patients using the first and second drop of blood. Venous blood glucose was measured meanwhile. The differences in blood glucose measurements were then compared in groups with different regions of blood glucose levels.
Results: There were 802 groups of blood glucose in 526 patients. There was no significant difference in the blood glucose levels of the first and second drop of blood and venous blood. However, after combining then dividing measurements into six groups according to blood glucose concentration, we found statistically significant differences between the blood glucose levels obtained from the first drop, second drop, and venous blood in the groups containing blood glucose values <9.9 or 20–30 mmol/L. In contrast, there were no significant differences in the 10–14.9 or 15–19.9 mmol/L groups.
Conclusions: In the clinical setting, both the first or second drop of blood can be used for performing SMBG to assess real-time venous glucose. By categorizing blood glucose into different levels more accurately, we observed that there was no significant difference between the first or second drop of blood and the venous blood glucose value when blood glucose levels were maintained between 10 and 20 mmol/L. When blood glucose levels were below 10 mmol/L, the value obtained from first drop of blood was close to that from venous blood, whereas when the blood glucose level is >20 mmol/L, the blood glucose value from the second drop of blood was more accurate.

1. Introduction

Monitoring blood glucose is an important component of the comprehensive management and treatment of diabetes. At present, the most popular method of blood glucose monitoring in the clinical setting is self-monitoring blood glucose (SMBG) by patients or medical stuff using blood glucose meters. However, guidelines have still not reached a unified standard in terms of the standardized protocol for SMBG,

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particularly regarding using the first or second drop of blood. Before 2010, most International guidelines and research recommended using the first drop of blood after washing hands [1–3], although some recommended the second drop of blood [4]. The official clinical operation standard for portable blood glucose measurements issued by Medical Institute of the Ministry of Health in 2010 recommended the use the second drop of blood [5]. Diabetes education on the 2013 ADA Website and the Diabetes UK Website, as well as the China Monitoring Guidelines of 2011 suggested that the flank and fingertip should be checked after cleaning hands; however, they did not emphasize the choice between the first or second drop of blood.

In this study, we employed SMBG in hospitalized patients by using the first and second drop of blood, and venous blood glucose was measured meanwhile. By comparing the differences in blood glucose measurements, including variations in blood glucose levels in different regions, a more suitable method for SMBG for use in the clinical setting could be defined.

2. Methods

2.1. Subjects

Patients with type 1 or type 2 diabetes who were hospitalized in the China Medical University First Affiliated Hospital from June 2012 to June 2013 were enrolled randomly. Fasting and/or 2 h after oral glucose tolerance tests (OGTT) blood glucose measurements were performed on fasted patients to measure blood glucose using the first and second drop of blood from the finger tip, and synchronous venous glucose. The Hospital Ethics Committee of the First Hospital of China Medical University approved the study, and all the patients provided written informed consent.

2.2. Measurements

Two types of blood glucose meter were used to measure blood glucose from the finger tip: the Bayer Bai An Kang blood glucose meter (glucose dehydrogenase method), red blood cell hematocrit 0–70%, and the Johnson Wen Hao blood glucose meter (glucose oxidase method), red blood cell hematocrit 30–50%. Both blood glucose meters employed hydrocodone-type blood sucking, required <1 μL of blood, and provided results within 8 s. Patients were not required to wash their hands before measurements, but were asked not to touch glucose-containing materials. The blood sampling site was the finger tip, which was wiped with 75% alcohol, dried, and the skin was pierced. The spontaneous overflowing drop of blood was the first drop of blood. Blood glucose was measured from this drop, which was then wiped away with a clean cotton swab. A parallel blood sampling site was then selected from the same site of the same finger, and the drop of blood obtained was the second drop of blood. And the same capillary blood glucose meter was used in the same patient for the two samples. When the blood glucose measuring was complete, venous blood was sampled and sent to the biochemistry laboratory to measure blood glucose. The entire process was complete within 5 min.

2.3. Measuring venous glucose

A Roche Modular DPP Biochemistry Analyzing Meter was used to measure serum glucose following the glucose oxidase method. The method of measurement was approved by the ISO15189 International Certification.

2.4. Statistics

Q_Q Diagram and Kolmogorov–Smirnov were used to examine the distribution of blood glucose. Data with normal distribution were presented as means with standard deviation, and analyzed by one-way analysis of variance (ANOVA). Data with abnormal distribution were presented as the median, and analyzed statistically using the Kruskal–Wallis test. The least significant difference (LSD) method was used to compare groups. All the data were analyzed using the SPSS ver. 13.0 Software. There were statistical differences when $P < 0.05$.

3. Results

There were 802 groups of blood glucose measurements from 526 patients, of which 526 were fasted and 276 were OGTT 2-h blood glucose. Of the fasted measurements, 330 were measured using the Bayer blood glucose meter, and 196 with the Johnson blood glucose meter. Of the post-prandial glucose measurements, 171 were measured using the Bayer blood glucose meter, and 105 with the Johnson blood glucose meter. Fasting blood glucose did not tail with the normal distribution, whereas 2 h OGTT did tail with normal distribution.

There was no difference in the whole analysis of 526 groups of fasting blood glucose, 276 2 h OGTT groups, and the blood glucose levels obtained from the first or second drop of blood, and venous blood ($P = 0.199$, $P = 0.612$, and $P = 0.587$, respectively). Fasting blood glucose using the Bayer meter $P = 0.614$; fasting blood glucose with the Johnson meter $P = 0.227$; postprandial blood glucose with the Bayer meter $P = 0.351$; postprandial blood glucose using the Johnson meter $P = 0.68$ (Table 1).

The fasting blood glucose and 2 h OGTT data were combined, and then stratified into 6 groups according to blood glucose concentrations: <5 mmol/L, 5–9.9 mmol/L, 10–14.9 mmol/L, 15–19.9 mmol/L, 20–24.9 mmol/L, and 25–30 mmol/L. Blood glucose values were then compared between the first and second drop of blood, and venous sampling within each group (Table 2 and Fig. 1). There were statistically significant differences in the values obtained from the first drop, second drop, and venous blood glucose in patients with blood glucose <5 mmol/L. We also compared each two groups using the LSD method, and observed differences between the first drop, second drop, and venous blood glucose ($P < 0.001$); however, the difference between the first and second drop of blood was not significant ($P = 0.071$).

There was also a statistically significant difference in the blood glucose levels between the first drop, second drop, and venous blood in the 5–9.9 mmol/L blood glucose group. When