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ORIGINAL ARTICLE

Effects of Simulated Altitude on Blood Glucose Meter Performance: Implications for In-Flight Blood Glucose Monitoring

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Abstract

Background:

Most manufacturers of blood glucose monitoring equipment do not give advice regarding the use of their meters and strips onboard aircraft, and some airlines have blood glucose testing equipment in the aircraft cabin medical bag. Previous studies using older blood glucose meters (BGMs) have shown conflicting results on the performance of both glucose oxidase (GOX)- and glucose dehydrogenase (GDH)-based meters at high altitude. The aim of our study was to evaluate the performance of four new-generation BGMs at sea level and at a simulated altitude equivalent to that used in the cabin of commercial aircrafts.

Methodology/Principal Findings:

Blood glucose measurements obtained by two GDH and two GOX BGMs at sea level and simulated altitude of 8000 feet in a hypobaric chamber were compared with measurements obtained using a YSI 2300 blood glucose analyzer as a reference method. Spiked venous blood samples of three different glucose levels were used. The accuracy of each meter was determined by calculating percentage error of each meter compared with the YSI reference and was also assessed against standard International Organization for Standardization (ISO) criteria. Clinical accuracy was evaluated using the consensus error grid method. The percentage (standard deviation) error for GDH meters at sea level and altitude was 13.36% (8.83%; for meter 1) and 12.97% (8.03%; for meter 2) with $p = .784$, and for GOX meters was 5.88% (7.35%; for meter 3) and 7.38% (6.20%; for meter 4) with $p = .187$.

There was variation in the number of time individual meters met the standard ISO criteria ranging from 72–100%. Results from all four meters at both sea level and simulated altitude fell within zones A and B of the consensus error grid, using YSI as the reference.

Conclusions:

Overall, at simulated altitude, no differences were observed between the performance of GDH and GOX meters. Overestimation of blood glucose concentration was seen among individual meters evaluated, but none of the results obtained would have resulted in dangerous failure to detect and treat blood glucose errors or in giving treatment that was actually contradictory to that required.

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Abbreviations: (BGM) blood glucose meter, (EGA) error grid analysis, (GDH) glucose dehydrogenase, (GOX) glucose oxidase, (ISO) International Organization for Standardization, (PE) percentage error, (SD) standard deviation, (SMBG) self-monitoring of blood glucose

Keywords: altitude, blood glucose meters, diabetes, self-monitoring blood glucose

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