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LETTER TO THE EDITOR

WILEY

First insights into the performance of the Dexcom G6 continuous glucose monitoring system during cardiac surgery using hypothermic extracorporal circulation

To the Editor

Our group has previously published the article 'Performance of a factory-calibrated, real-time continuous glucose monitoring system during elective abdominal surgery' in *Diabetes, Obesity and Metabolism*.[1] This brief report demonstrated satisfying accuracy of the Dexcom G6 continuous glucose monitoring (CGM) during complex abdominal surgery. However, it is not known whether the Dexcom G6 sensor functions properly during non-pulsatile extracorporeal circulation (ECC) and hypothermia, which alter subcutaneous circulation with a potential impact on glucose exchange dynamics between blood and interstitial compartments.

To our knowledge, we present the first insight into the performance of the Dexcom G6 sensor during cardiac surgery with mild and deep hypothermia in two patients with type 2 diabetes. The factory calibrated Dexcom G6 sensor was inserted with the patients' consent on the lateral abdominal wall 12 h before surgery onset. Approval for the assessment of two pilot cardiac surgery patients was granted by the local ethics committee by an extension of the study reported by Tripyla *et al*.[1] (BASEC-ID 2019-00751). Intraoperative CGM readings were compared with venous plasma glucose values measured routinely using a blood gas analyser (BGA; GEM Premier 4000). No CGM

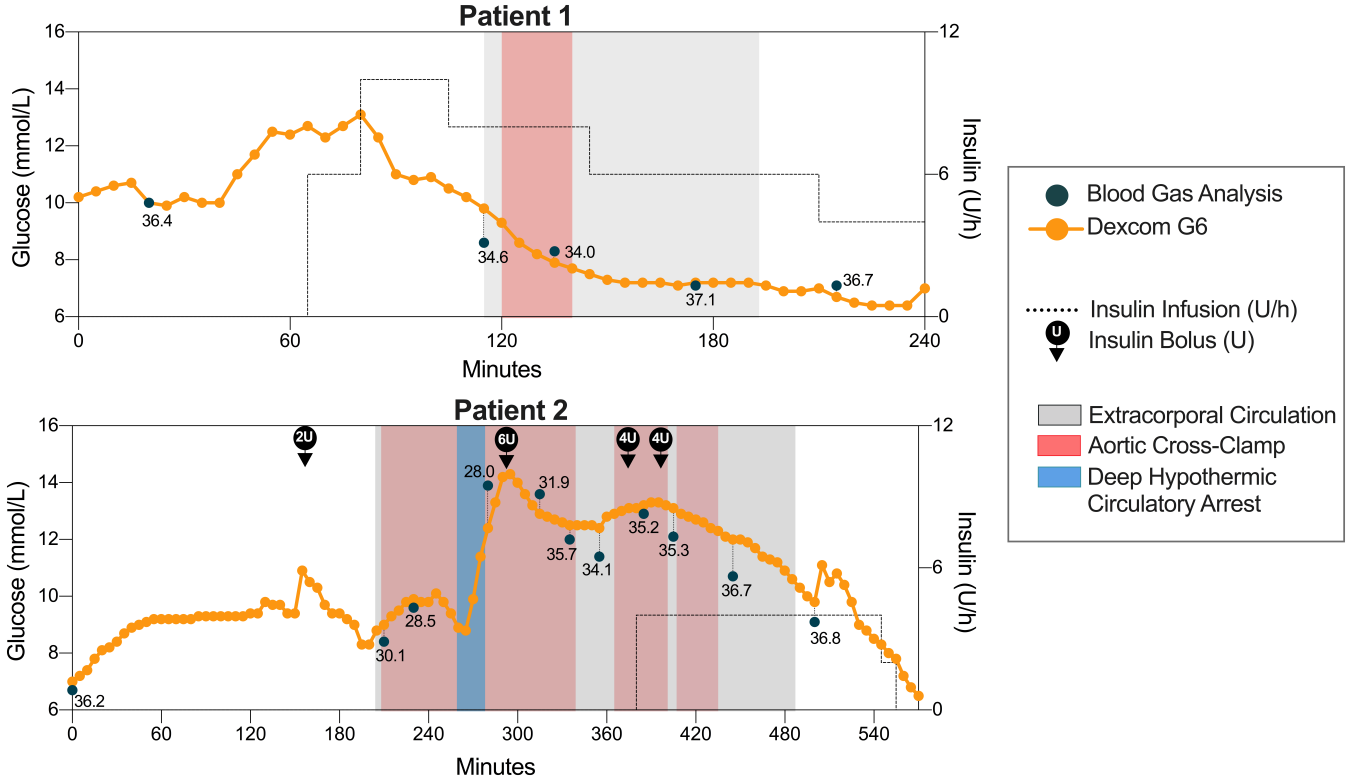

FIGURE 1 Continuous glucose monitoring (CGM) readings of two patients with type 2 diabetes during cardiac surgery. Patient 1 underwent mild hypothermia on extracorporal circulation (ECC) during cardiac surgery with lowest temperature of 34°C. Patient 2 underwent cardiac surgery on ECC with a deep hypothermic circulatory arrest (DHCA) at 28°C. Aortic cross clamp, DHCA, ECC times, insulin doses and blood glucose reading from venous blood gas analysis with the respective body core temperatures are displayed along CGM reading

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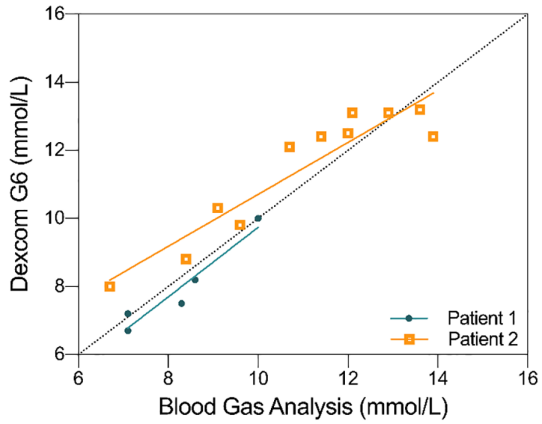

FIGURE 2 Agreement between CGM and blood glucose readings acquired from venous blood gas analysis. Values for patient 1 are shown in blue and in orange for patient 2, plotted with a line of index

calibration occurred during surgery. The mean absolute relative difference (MARD) was reported per patient.

Patient 1 was treated with insulin degludec/metformin. Degludec was reduced to 50% of the normal dose on the day of surgery according to the institutional protocol, metformin was discontinued on the day of surgery, and the patient underwent coronary artery bypass graft surgery with ECC at 34°C. In this patient, the CGM measurement showed good agreement with glucose concentrations obtained from BGA measurements. The upper panel in Figure 1 shows the extracted CGM readings and BGA results obtained at specific time points during surgery (MARD 4.3% ± 3.8%). Oesophageal temperatures are provided in Figure 1 with the BGA glucose results. Initiation and discontinuation of ECC (grey shaded area), aortic cross-clamp time (red shaded area), intravenous continuous insulin infusion rate (black dotted line) and bolus applications are depicted. Figure 2 shows the relationship between Dexcom G6 CGM readings and BGA of both patients. The sensor functioned properly throughout its normal 10-day life cycle postoperatively without any sensor drop-outs.

Patient 2 was treated with metformin/sitagliptin (discontinued on the day of surgery) and was scheduled for coronary artery bypass graft surgery, aortic valve replacement and replacement of the ascending aorta and aortic arch in deep hypothermic cardiocirculatory arrest (DHCA). The patient was cooled to 28°C for replacement of the ascending aorta and aortic hemi-arch. For DHCA, ECC was stopped for 19 min with only selective antegrade perfusion of the carotid arteries for 11 min. Subsequently, the patient was slowly rewarmed to normothermia for the remainder of the surgery. Even during DHCA, when blood flow to the entire body with exception of the brain was stopped, the Dexcom G6 CGM provided readings with acceptable deviation from the BGA measurements (MARD 8.1% ± 5.6%). Larger deviations from BGA occurred later during the surgery, after four intravenous insulin boli were administered and continuous intravenous insulin infusion was instated. These deviations probably result from the lag for detection of subcutaneous glucose oscillations compared with the intravascular compartment. The lower panel in Figure 1 outlines the trajectories of glucose values. Core temperatures obtained from the urinary catheter tip and DHCA time (blue shaded area) is shown. The sensor had to be removed on the fourth postoperative day, due to an emergency magnetic resonance imaging scan, until then the sensor functioned normally.

In conclusion, these two cases demonstrate the feasibility of glucose detection by the Dexcom G6 CGM in comparison with measurements by BGA in more extreme pathophysiologic conditions, that is, deep hypothermia and even cardiocirculatory arrest during cardiac surgery. More studies are now warranted to assess systematically the accuracy of next generation CGM systems in such challenging conditions. In the face of emerging subcutaneous closed-loop systems depending on CGM, the accuracy of CGM in such conditions is of paramount importance for safe perioperative glucose management.

PEER REVIEW

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REFERENCE

1. Tripyla A, Herzig D, Joachim D, et al. Performance of a factory-calibrated, real-time continuous glucose monitoring system during elective abdominal surgery. *Diabetes Obes Metab*. 2020;22:1678-1682.