



Continuous Glucose Monitoring in the Operating Room and Cardiac Intensive Care Unit

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M. Citlalli Perez-Guzman,¹
Elizabeth Duggan,² Seid Gibanica,¹
Saumeth Cardona,¹
Andrea Corujo-Rodriguez,²
Abimbola Faloye,² Michael Halkos,³
Guillermo E. Umpierrez,¹ Limin Peng,⁴
Georgia M. Davis,¹ and
Francisco J. Pasquel¹

Rapid implementation of remote continuous glucose monitoring (CGM) is occurring across hospitals during the coronavirus disease 2019 (COVID-19) pandemic. Despite limited experience, the U.S. Food and Drug Administration is not objecting to the inpatient use of CGM to limit the exposure of health care workers to severe acute respiratory syndrome coronavirus 2 and to reduce the waste of personal protective equipment (1). Recent efforts in non-intensive care unit (ICU) patients suggest that CGM devices are accurate in the inpatient setting and can help monitor patients remotely (2,3). In addition, two recent small trials enrolling non-ICU patients confirm the feasibility of using remote real-time CGM in the hospital (4,5).

The accuracy of sensors, however, may be affected during various conditions that have not been well studied (i.e., MRI, surgery, shock requiring vasopressor therapy, hypoxia) (1). To mitigate potential CGM inaccuracy, a hybrid approach using real-time CGM with periodic point-of-care (POC) validation has been suggested (1). We report here on the likely loss of sensor signal during cardiac surgery and potential loss of accuracy in the operating room (OR). We also report on the accuracy of sensors that recovered immediately after surgery during critical illness.

We evaluated the performance of sensors in adults without diabetes undergoing scheduled or urgent coronary artery bypass surgery (CABG). We excluded patients with severely impaired renal function, hepatic failure, or imminent risk of death. We inserted a blinded Dexcom G6 CGM (Dexcom, San Diego, CA) device in the lower abdomen preoperatively. Glycemic data were collected before, during, and after surgery. Blood glucose values were paired with concomitant sensor values for analysis. The Emory University Institutional Review Board approved the study.

Fifteen consecutive patients were included. Thirteen patients underwent open CABG (cardiopulmonary bypass $n = 13$, off-pump $n = 2$), and robotic CABG was performed in two patients. All patients received continuous insulin infusion. Patient characteristics are listed in Fig. 1A. A total of 149 paired POC-CGM measurements were used for analysis. The mean and median absolute relative differences were 12.9% and 10.5%, respectively. Clarke Error Grid analysis showed 98.6% of glucose values falling into zones A and B; 83.2% of values fell within zone A, 15.4% within zone B, and 1.3% within zone D. No values fell within zone C or E (Fig. 1). The proportion of

sensor glucose values within $\pm 15\%/15$ mg/dL, $\pm 20\%/20$ mg/dL, and $\pm 30\%/30$ mg/dL of the reference value (± 15 , 20, or 30% if reference BG >100 mg/dL or ± 15 , 20, or 30 mg/dL if reference BG <100 mg/dL) was 69%, 82%, and 94%, respectively.

To illustrate the performance of sensors during surgery, individual-level data are presented for patients 1–8 in Fig. 1C and D. We observed that sensors were accurate before surgery; however, intermittent signal loss was common during the operative course. After surgery, some sensors maintained precision (following POC patterns in parallel [Fig. 1D]) but lost accuracy (predominantly negative bias), particularly those with longer signal gaps. Six sensors recovered accuracy after surgery (within 20% of reference values). Sensors that recovered accuracy maintained reliable readings despite vasopressor therapy (Fig. 1B). We did not observe differences in complications, length of stay, or transfusions between patients wearing the recovering devices and those wearing nonrecovering devices.

In non-ICU populations, recently Nair et al. (2) ($N = 10$ non-COVID-19, 178 glucose pairs) and Reutrakul et al. (3) ($N = 9$ COVID-19⁺, 105 glucose pairs) reported mean absolute relative differences of 9.4% and 9.8% with G6, respectively.

¹Division of Endocrinology, Metabolism, and Lipids, Department of Medicine, Emory University School of Medicine, Atlanta, GA

²Department of Anesthesiology, Emory University School of Medicine, Atlanta, GA

³Division of Cardiothoracic Surgery, Department of Surgery, Emory University School of Medicine, Atlanta, GA

⁴Rollins School of Public Health, Emory University, Atlanta, GA

Corresponding author: Francisco J. Pasquel, fpasque@emory.edu

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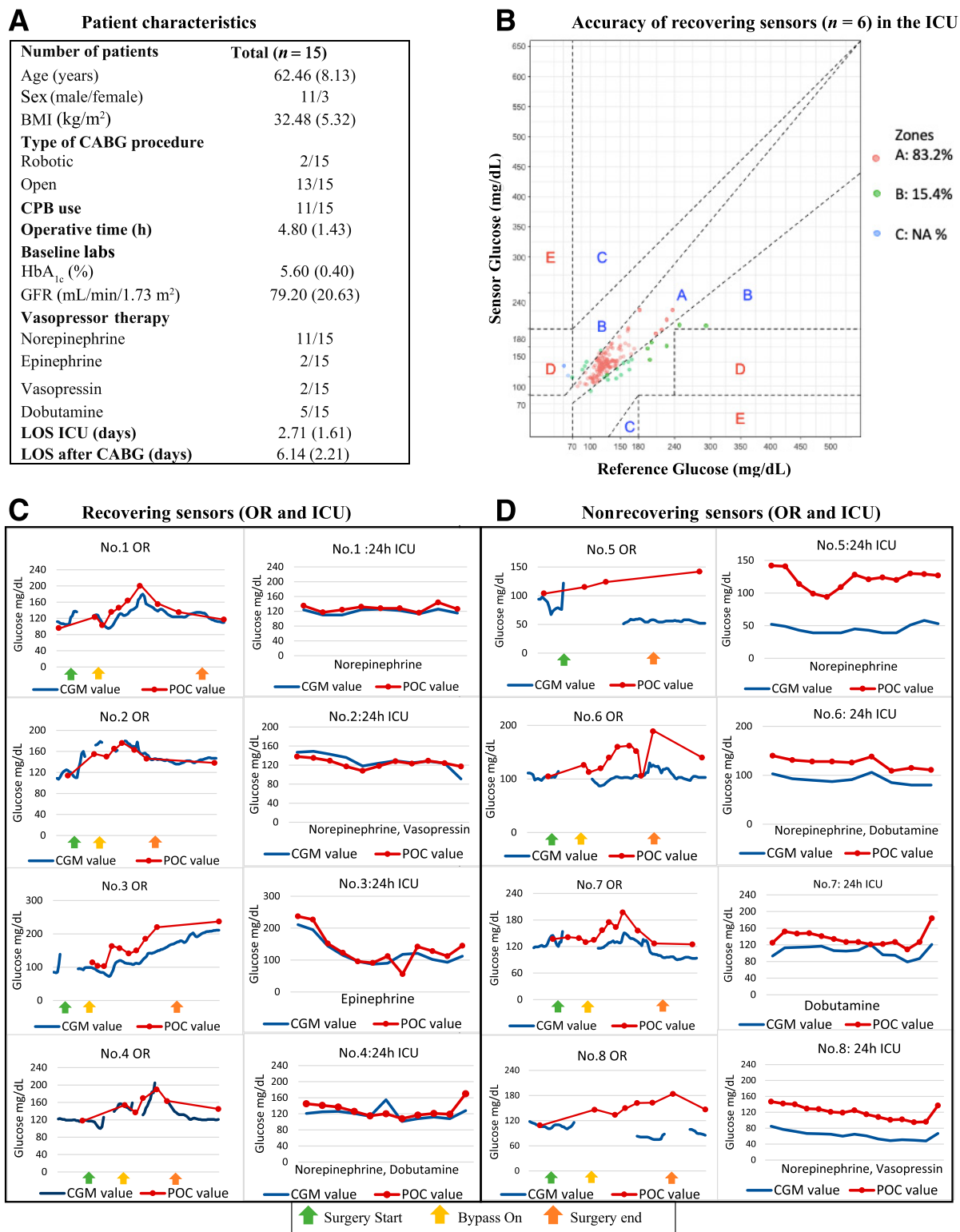


Figure 1—Patient characteristics (A), sensor accuracy (B), and individual-level data in patients receiving vasopressors in the cardiac ICU (C and D). CPB, cardiopulmonary bypass; GFR, glomerular filtration rate; LOS, length of stay.

We confirm and expand these findings with data from critically ill patients on vasopressor therapy. We acknowledge potential limitations: even though most POC samples are from arterial blood, there may have been intermittent capillary

samples in the ICU. These findings cannot be extrapolated to the hypoglycemic range.

In summary, this information is extremely relevant because 1) we documented that CGM technology is less reliable

in the OR, which is likely related to electrocautery interference; 2) we show common patterns of signal loss and negative bias during surgery; however, 3) we observed that sensors that recovered immediately after surgery had

adequate and sustained accuracy, even during exposure to vasopressors in the ICU. Our preliminary experience during the COVID-19 pandemic indicates that CGM use is helpful in the ICU to guide therapy in patients that require continuous insulin infusion to maintain glucose control, where hourly POC tests are extremely impractical. This information provides initial reassurance to providers that are using the technology in the sickest patients aiming at achieving better glycemic control while reducing the burden of diabetes care during the pandemic. We recommend avoiding making clinical decisions based on CGM readings after surgery until accuracy can be confirmed (e.g., within 20% of reference values) with POC testing or central laboratory tests. We do not know if calibration can improve the performance of CGM devices during or after surgery. Until we have more information, placement of a new device may be necessary.

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of the data and the accuracy of the data analysis.

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