Postoperative glycemic variability in diabetic and non diabetic patients

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Objective:

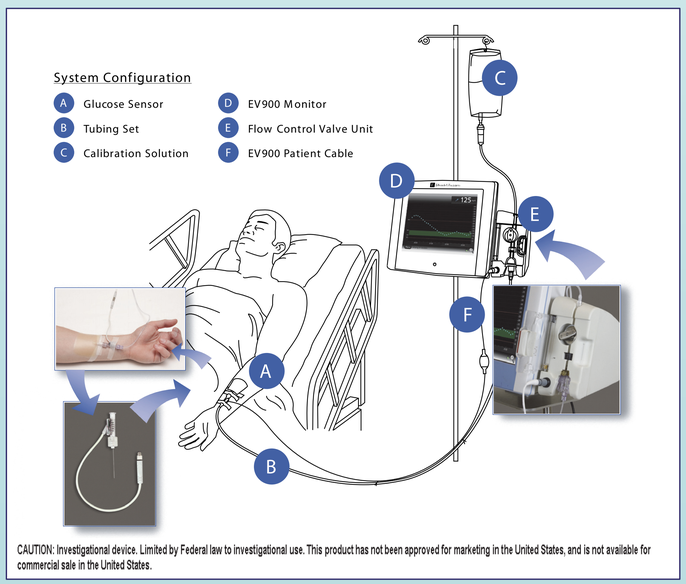
Glycemic variability increases oxidative stress and may trigger the inflammation and coagulation cascades (1). Variability may be associated with increase morbidity and mortality in ICU patients (2). We analyzed glycemic variability after major surgery in diabetic (DM) and non-diabetic (NDM) patients using an automated intravenous blood glucose monitor (IVBG). (Figure 1)

Table 1. Descrive statistics

	Non DM	DM Type 2	P
Number of subjects	17	8	
Sex (M/F)	9/8	3/5	0.497
Age (year)	59.2±12.3	63.4±4.4	0.234
BMI (kg/m^2)	29.0±5.0	39.5 ±9.0	0.013*
ASA Physical Status	2.7 ±0.5	3.0 ±0.5	0.139
HbA1c	5.8 ±0.4	7.5 ±1.1	0.006*
Surgery time (hours)	5.7 ±4.0	5.4 ±2.7	0.850
ICU time (hours)	32.7 ±24.8	36.4 ±12.3	0.631
Study Duration (hours)	59.7±14.5	66.4±7.8	0.148

Data are mean±SD.
* P < 0.05
DM – Diabetes Mellitus, BMI – Body Mass Index, ASA – American Society of Anesthesiologist, ICU – Intensive Care Unit, IQR – Interquartile Range

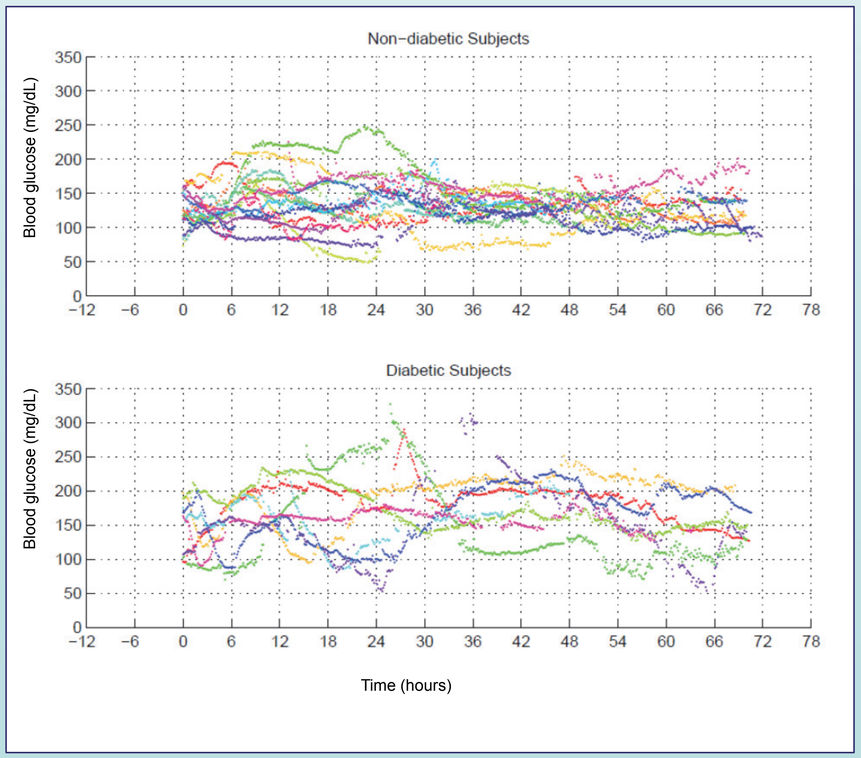
Figure 1. Automated blood glucose monitor set up



Methods:

After institutional IRB approval, 28 patients undergoing abdominal surgery with an anticipated ICU stay for at least 24 hours were enrolled in a prospective, blinded, observational study. An investigational Intravenous Blood Glucose Monitoring System (Edwards Lifesciences, Irvine, CA) was used for continuous blood glucose (BG) monitoring. The IVBG sensor was inserted into the lumen of a peripheral venous catheter and attached to a bedside monitor prior to surgery. The BG concentration was automatically measured every 7 to 8 minutes for a maximum of 72 hours by the IVBG monitor in a blinded fashion. IVBG measurements were compared with reference BG analyzer measurements (YSI-STAT 2300).
Glycemic variability was calculated using standard deviation (SD). Data were analyzed using 2-tailed t-test.

Figure 2. Automated blood glucose data from diabetic and non-diabetic subjects



Results:

Eight patients with T2DM and 17 patients without diabetes were analyzed. There was no difference in sex, age, ASA status, duration of surgery and length of ICU stay between the groups (Table 1). Patients underwent aortic valve replacement surgery (2), pancreas resection or Whipple procedure (19), liver resection (1), and esophageal resection (3). DM patients had a significantly higher mean BG than NDM patients (164.7±16.2 vs. 131.6±14.6 mg/dl, respectively, p<0.001), pre-op HbA1c (7.5±1.1 vs. 5.8±0.4 %, p=0.006) and BMI (39.5±5.1 vs. 29.0±9.0 kg/m2, p=0.013) (Table 1). Glycemic variability was significantly increased in DM patients compared with NDM patients (Figure 2). Average glucose SD for each patient's IVBG measurements was 38.0±15.2 vs. 24.3±9.4 mg/dl, respectively, p=0.042 (Table 2).
The IVBG monitor and YSI measurements compared closely (6.5 % mean absolute relative difference, 95.2% BG values within 15/20 ISO 15197 and 94.3% of paired data in Clarke Error Grid zone A and 5.7% in zone B).(3)

Table 2. Blood glucose data

	Non DM	DM Type 2	P
Number of subjects	17	8	
Mean Glucose (mg/dL)	131.6 ±14.6	164.7 ±16.1	<0.001*
Median Glucose (mg/dL)	128.1±13.5	163.9 ±27.6	0.008*
Average Glucose SD (mg/dL)	24.3 ±9.4	38.0 ±15.2	0.042*
IQR (mg/dL)	38.6 ±19.8	49.0 ±24.0	0.308

Data are mean±SD.
* P < 0.05
DM – Diabetes Mellitus, IQR – Interquartile Range

Conclusion:

DM patients had a significantly higher mean BG and glycemic variability. A prospective study is needed to evaluate if minimizing hyperglycemia, hypoglycemia, and glycemic variability with an automated glucose monitor and insulin can influence clinical outcome after major surgery.

References:

1. Monnier L. et al. Activation of Oxidative Stress by Acute Glucose Fluctuations Compared With Sustained Chronic Hyperglycemia in Patients With Type 2 Diabetes. JAMA 2006; 295: 1681-7
2. Egi M et al. Reducing Glycemic Variability in Intensive Care Unit Patients:A New Therapeutic Target?JDST 2009; 3: 1302-8
3. Joseph J, et al. Performance of an Automated Blood Glucose Monitor in the Operating Room and Intensive Care Unit. ASA meeting 2010. A885.

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