Perioperative Use of the Glucommander® for Glucose Control in Patients Undergoing Cardiac Surgery

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Introduction

Hyperglycemia is a common perioperative problem in both diabetic and non-diabetic patients undergoing cardiac surgery.[1] Perioperative hyperglycemia is associated with increased morbidity and mortality, mainly in the form of infectious complications.[2] In addition, hypoglycemia in cardiac surgery patients has been associated with increased morbidity and mortality.[4] Thus, both hyperglycemia and hypoglycemia in cardiac surgery patients have adverse consequences. Multiple studies have illustrated the importance of glycemic control in the cardiac surgical patient.[2-6]

The Glucommander® (Glytec Systems, Greenville, SC) is a computerized algorithm designed to direct the administration of intravenous insulin by continuous infusion. Calculation of the insulin dose requires a target glucose range, the present glucose value, and a multiplier that takes into account a patient's changing insulin sensitivity. Once the Glucommander® is initiated, it continually calculates the optimal dose of intravenous insulin to maintain blood glucose within the goal range. This study evaluated our hypothesis that the Glucommander® would lead to improved blood glucose control as compared to the standard care insulin protocol during the perioperative period in cardiac surgery patients.

Materials & Methods

After approval from the Institutional Review Board at the University of Virginia and written informed consent was obtained, 65 patients having cardiac surgery were prospectively randomized to the Glucommander® (30 patients) or the standard care insulin protocol group (35 patients). Both diabetic and nondiabetic patients were included. For both groups arterial blood glucose measurements were analyzed every 30 minutes in the operating room and hourly in the intensive care unit (ICU) for 24 hours postoperatively.

The Glucommander® and acute care protocols were activated intraoperatively once the blood glucose level reached 120 mg/dl with a set target range of 120-150 mg/dl. The Glucommander® and standard care protocols were continued postoperatively in the ICU for 24 hours.

To analyze the efficacy of the Glucommander® we constructed nested, mixed-effect models using NONMEM (version 6, ICON Development Solutions, Ellicott City, MD) to compare average glucose and glucose variability over the entire study period. Models included the following covariates: age, BMI, height, weight, Hgb A_1C, and epinephrine infusion dosage. The potential impact of each covariate was also calculated using mixed-effect model.

The incidence of severe hypoglycemia and the number of measurements within the target range were compared using the Chi-square test.

Results

Patients randomized to the Glucommander® had better glycemic control than those treated with the standard care insulin protocol. Over the entire study period, patients in the Glucommander® group had a lower average glucose than patients in the standard group (Table 1). Patients in the Glucommander® group also had a non-significant trend towards less variability in glucose (Table 1).

In the Glucommander® group, 43% of all glucose measurements were within target range of 120-150 mg/dl compared with 32% of controls (p=0.001). Patients in the Glucommander® group had glucose values ≤ 150 mg/dL 82% of the time as compared to 58% of the time in the standard group (p<0.0001). There were 14 episodes of hypoglycemia (≤ 90 mg/dl) in the Glucommander® group as compared to 15 episodes in the standard care group (p = 0.758).

There were 0 episodes of severe hypoglycemia (≤ 60 mg/dl) in the Glucommander® group as compared to 1 episode in the standard care group (p = 0.351).

Only two covariates, Hgb A1C and Epinephrine infusion dose, were identified as having a statistically significant impact on glucose among patients in the Glucommander® group (Table 2).

TABLE 1: Glucose Data

	Glucommander® Group	Standard Group	P-value
Average glucose over 24 hours (mg/dl)	**129 ± 12.4**	**145 ±15.8**	**<0.001**
Glucose variability (over 24 hours)	6.78	10.1	0.231

TABLE 2: Impact of Patient Characteristics on Glucose in Patients in the Glucommander® group

Variable	Correction Factor (per unit)	P-value
Age (years)	-0.078	0.266
BMI (kg/m²)	0.357	0.087
Epinephrine (mcg/minute)	**0.230**	**<0.001**
Height (cm)	0.091	0.282
Hemoglobin A_1C (percentage)	**5.72**	**0.019**
Weight (kg)	0.076	0.288

Conclusions

The Glucommander represents a helpful tool for achieving glycemic control in cardiac surgical patients. In this prospective, randomized controlled study, a statistically significant improvement in blood glucose was noted with the use of the Glucommander® during the study period as compared to standard treatment. Use of the Glucommander® was not associated with a significant risk of severe hypoglycemia. Further studies will help elucidate how this specialized tool may be utilized to improve glycemic control and variability in cardiac surgical patients and whether or not this results in improved outcome.

References

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