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GLYCEMIC OUTCOMES THREE YEARS AFTER IMPLEMENTATION OF A PERIOPERATIVE GLYCEMIC CONTROL ALGORITHM IN AN ACADEMIC INSTITUTION

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Running title: perioperative glycemic control

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Abstract

Objective: While hyperglycemia in the postoperative setting has been linked to an increase in surgical complications, limited data is available to inform the management of patients with diabetes (DM) in the operating room and the immediate perioperative period. We describe the results of a perioperative glycemic control program that standardized intravenous insulin with a target glucose (BG) range of 120-180 mg/dL for patients with DM presenting with a BG level > 180mg/dL and included transition to subcutaneous insulin.

Methods: Patients with known DM and a BG > 180mg/dL who underwent surgery were included. The control group included 260 patients from March 2, 2008 through December 31, 2008. The intervention group included 588 patients following protocol implementation from April 1, 2009 through December 31, 2012. Data included demographic information, hospital BG values, length of stay (LOS), mortality and wound infections.

Results: The intervention group had significantly lower BG on arrival in the postoperative care unit (182.2 vs 194.9 mg/dL, p=.012). Mean BG during the first 24 hours after surgery was lower in the intervention group (182.1 vs 190.5 mg/dL) and there were fewer BG values >200 mg/dL in the intervention group (p=0.005). The percentage of BG values <70 mg/dL was lower in the intervention group (1.94 vs 2.43%, p<0.01). There was no significant difference in mortality, LOS or wound infections.

Conclusion: Following implementation of a hospital-wide perioperative glycemic control algorithm we found a reduction in perioperative BG levels and rates of hypoglycemia. Ongoing research is needed to assess the impact on clinical outcomes.

Abbreviations:

DM = diabetes, **BG =** blood glucose, **LOS =** length of stay**, POC =** point-of-care, **OR =** operating room, **EHR =** electronic health record**, IV =** intravenous**, PACU =** post-operative care unit, **CCI =** Charlson Comorbidity Index.

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Background

Over the past decade there has been an increasing awareness of the adverse consequences of hyperglycemia in hospitalized patients. Patients with and without known diabetes who manifest hyperglycemia during a hospital stay have been shown to have higher mortality rates, longer length of stay (LOS), and increased rates of infections and cardiovascular complications (1-4). Intraoperative glycemia has to date received comparatively little study, despite indications that perioperative hyperglycemia is also linked to adverse outcomes (5-7). Current guidelines for the management of perioperative glycemia rely on extrapolated data mainly obtained in the critically ill patient population. These are tempered by concerns specific to the operative setting, including technical limitations with point-of-care (POC) glucose monitoring devices and the risk of unrecognized hypoglycemia in the sedated patient. Based on the available data some authors have indicated that maintaining blood glucose (BG) levels <180 mg/dL while in the operating room (OR) is reasonable (9, 10).

In 2008 Boston Medical Center convened a multidisciplinary working group to develop a standardized approach to the management of patients with diabetes who present for elective surgery. Prior to the protocol described below, there was no standard hospital practice for the management of perioperative hyperglycemia. It was most frequently treated with subcutaneous regular insulin, while insulin infusions were mainly used in cardiothoracic surgery patients. Subcutaneous scheduled insulin was rarely administered in the immediate postoperative period. , While there is excellent published randomized and controlled data that addresses postoperative BG control, there is little description of the real-world practice of using insulin in the perioperative period in patients undergoing routine surgical procedures. Here we present our experience in the creation and implementation of the protocol and also a retrospective analysis of glucose outcomes before and after implementation of the protocol.

Program Development and Overview

We convened a multidisciplinary task force involving key stakeholders including anesthesiology, endocrinology, surgery, medicine, pharmacy and nursing to develop and implement a perioperative glycemic management program. Early meetings centered on identifying the structure of preoperative evaluation, reviewing existing patient instructions on perioperative diabetes management and understanding workflows in the preoperative, intraoperative and postoperative arenas. Including staff who were involved in the day to day management of the perioperative patient was integral to development of a successful program.

Material assessment revealed inadequate access to POC glucose testing in the preoperative and postoperative care units as well as in the ORs. The hospital administration heeded the Task Force recommendation to add two additional POC glucose meters in the perioperative care areas and two additional meters in the OR. Educational sessions were provided across the organization prior to protocol implementation. At our institution, anesthesiology manages insulin therapy intraoperatively but nursing staff manage glycemic control in the preoperative and postoperative periods via a

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standardized protocol. Providing education to the correct staff and in the right forum was key to clinician acceptance to practice change. Perioperative nursing staff was educated through in-services provided by a pharmacist specializing in inpatient diabetes management. These sessions included discussion regarding the reasons for the initiative and detailed case-based reviews of the algorithms and infusion protocols. Task force members provided education to anesthesiology through lectures given by an endocrinologist and an online training module. The educational sessions allowed end users to provide feedback on anticipated problems or concerns with the proposed protocols. Following the education phase the protocol was rolled out in one OR suite for three months and patients were prospectively tracked. Upon completion of the pilot the protocol was reviewed for safety and process challenges were addressed. The protocol was applied only to patients with known diabetes. A more detailed discussion of the design and implementation of the program was previously reported (11).

The protocol begins with identification of diabetes during the preoperative visit. On the day of the scheduled surgery, intake nurses review the patient's history for a diagnosis of diabetes. Both glucose monitoring and insulin therapies are ordered by default in all preoperative order sets in the electronic health record (EHR). All patients with diabetes have a POC blood glucose value assessed prior to any operative procedure. Based on the presence of type 1 or type 2 diabetes and the expected duration of procedure, different algorithms are followed (Figures 1a-c). Insulin via intravenous (IV) infusion was the recommended therapy, however for very short procedures (<1 hour), low doses of IV insulin boluses could be given. As infusions are typically titrated only one time per hour, it did not seem practical to start an infusion in patient who was to be in the OR only a very short time. By including insulin orders proactively into preoperative orders, delay in addressing hyperglycemia is reduced and the bedside nurse has the necessary tools to rapidly assess and treat patients appropriately. Upon transfer of the patient to the OR, the nurse provides the anesthesiologist with a paper handoff sheet with the insulin titration protocol along with information about the most recent BG, insulin rate, and when the next BG check is due. The protocol is a standard variable rate continuous infusion which calls for a goal BG range of 120-180 mg/dL. A low dose of a dextrose infusion is continued while the patient is on the insulin infusion. Insulin is titrated by the anesthesiologist in the operating room and a similar hand-off is completed in the postoperative care unit (PACU). Most BG monitoring was done via bedside point-of-care (POC) glucose meters (Roche ACCU-CHEK Inform II). The limitations to using POC meters to assess BG levels are well described and mainly of concern in critically ill patients. These limitations were discussed with the anesthesiology group, and providers could also monitor BG levels via samples from an arterial line or venous blood gas in the central laboratory. However since arterial lines were rarely used for routine surgeries, it was felt that the morbidity of placement was not justified for all patients. The protocol called for patients to receive a consult by the Inpatient Diabetes consult service upon arrival to the PACU to assess for a transition to subcutaneous insulin. Patient were prescribed a tailored weight-based basal-bolus insulin program as appropriate. Overlap time with the insulin infusion and long-acting insulin is typically 1-2 hours. The protocol itself focused on the use of IV insulin in the perioperative period to lower BG levels and diabetes team consultation immediately postoperatively to provide recommendations for subcutaneous insulin. Patients were then followed by the diabetes team to adjust insulin for the remainder of their hospital stay as per already existing standard of care at our institution. Inpatient management of hyperglycemia outside of the perioperative period was not different between the intervention and control eras. There was a standard methodology in wide practice that included evidence based weight based basal bolus insulin therapy as the mainstay.

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Our general approach to dosing subcutaneous insulin in the PACU was to administer 0.25 units/kg of glargine for patients receiving <2 units/hour on the insulin infusion, and 0.3 units/kg of glargine for patients on higher infusion rates. Patients with advanced kidney disease and the elderly were given lower doses. Patients were placed on lispro premeal in proportion to the basal insulin if they were to be eating, and a sliding scale of lispro every 4 hours or regular insulin every 6 hours if not eating. While this was our general approach, all patients were seen by the Diabetes team and thus the therapy was tailored for the individual patient and situation. Therapy was also adjusted based on clinical factors such as whether the patient had long-acting insulin on-board that they had administered prior to the surgery, and if the patient had received glucocorticoids during the operation. These modifications were based on physician judgement and dosing was based on best practice of basal-bolus insulin and not a strict protocol.

Prior to the protocol our hospital already had in place an inpatient diabetes consult service, consisting of an Endocrinology fellow and attending, as well as residents and students. No additional staff resources at our institution were required from a nursing or physician standpoint. The formal cost of the program included a small initial sum to purchase six additional glucometers for the perioperative areas, as well as ketostix. After the protocol was implemented, there was an increase in the use of regular insulin infusions, which cost less than $2.50 per bag.

Methods and Data analysis

The program was implemented hospital-wide in 2009. In order to investigate the effectiveness of the clinical protocol we performed a retrospective analysis of glycemic control in surgical patients using perioperative and postoperative glucose levels, as well as other clinical measures such as LOS, readmission and mortality rates, and compared them to a historical control group.

The study was conducted among patients with a diagnosis of diabetes by ICD-9 code who were admitted to Boston Medical Center following surgery. The control group consisted of patients who underwent surgery from March 1, 2008 through December 31, 2008. Patients who had surgery between January 1, and March 31, 2009 were excluded as the perioperative protocol was piloted during that time. The intervention group consisted of patients who underwent surgery from April 1, 2009 through December 31, 2012. IRB approval was obtained through Boston University Medical Center. A retrospective chart review was conducted and both the intervention and control groups were identified using data extracted from the EHR. The final data set of both groups included demographic variables along with other key clinical outcomes such as LOS, hospital readmission, mortality, most recent serum creatinine prior to surgery and hemoglobin A1c (if obtained within three months prior to surgery).

The intervention group included all patients with diabetes who were hyperglycemic upon arrival for surgery (defined as glucose level >180 mg/dL) and who underwent surgery after implementation of the perioperative glycemic management protocol. Only patients who were hospitalized following surgery were included for analysis. The control group was identified as patients with diabetes who were hyperglycemic and who underwent surgery prior to protocol initiation and who remained in the hospital postoperatively. Patients who were less than 18 years old, had a preoperative BG < 180 mg/dL, pregnant, undergoing cardiothoracic surgery or were admitted to the intensive care unit were excluded

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from the study. This was because such patients were not part of the population in whom the protocol was implemented. Patients who did not have a BG checked in the preoperative and perioperative time period were also removed as safety and efficacy of the protocol could not be assessed.

The primary outcome of the study was mean 24-hour postoperative glucose levels, defined as the mean of all glucose levels, including both POC and lab-measured glucose results, measured from the time when surgery ends through to 24 hours after. Glucose variability was measured using the standard deviation of glucose levels. Hypoglycemia rate was defined as the percentage of all glucose values that were <70 mg/dL. Mean glucose level and glucose variability were compared using a two sample t-test at a significance level of 0.05. A comparison of hypoglycemia and hyperglycemia rates between the two groups was carried out using a chi-square test at alpha=0.05.

Postoperative infection rates were determined by the number of infections as documented by ICD-9 code. All patient ICD-9 codes were analyzed to compare patient severity of illness via Charlson Comorbidity Index (CCI) (12). Intervention and control groups were compared on all key clinical and demographic variables using a Student t-test for numerical variables and a chi-square test for categorical variables, at a significance level of 0.05. All statistical analysis was performed using SAS 9.3.As part of the secondary analyses, we aimed to ascertain whether any differences in the primary outcome were due to the intervention itself and not as a result of any other baseline characteristics which may differ between the control and intervention groups. In order to do this we performed multiple linear regression analysis while adjusting for other variables which may be potential confounders.

Results

A total of 866 and 1,735 patients with diabetes underwent surgery with subsequent hospital admission during the control and intervention time periods respectively. After exclusions, the final analysis contained 260 patients in the control group and 558 patients in the intervention group. Most patients were excluded due to a lack of BG measurements.

Patient characteristics are shown in Table 1. The groups were well-matched in terms of age, baseline hemoglobin A1c, creatinine and BMI. Charlson comorbidity index (CCI) and male gender were higher in the intervention group, and there were slight differences in racial distribution.

The mean duration of surgery was similar between groups, and there was a slight increase in the number of BG checks done in the intervention group while in the OR. The intervention and control groups presented for surgery with a similar mean BG, 224.7 ± 48 mg/dL vs 229.8 ± 54.4 mg/dL respectively (Table 2). The intervention group had significantly lower BG levels upon arrival in the postoperative care unit, 182.4 ± 57.6 mg/dL compared to 194.9 ± 68.2 mg/dL (p=0.0119). Mean intraoperative BG was lower in the intervention group, while glucose variability intraoperatively was similar between the 2 groups. Mean BG during the first 24 hours after surgery was lower in the intervention vs the control group, 182.1 ± 44.0 mg/dL and 190.5 ± 50.7 mg/dL respectively (p=0.0232). In addition there were fewer glucose values > 200 mg/dL in the intervention group during that time period. As there was a trend toward a lower preoperative BG in the intervention cohort and a significantly higher CCI, we used a linear regression model to assess for the effects of these variables on 24 hour postoperative BG levels, mean intraoperative BG levels, percentage of BG > 200 mg/dL and hospital rates of hypoglycemia. The results continued to remain significantly different between the 2

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groups for all outcomes with the exception of mean intraoperative BG, where the p value changed from 0.0071 to 0.0958 with regression analysis (data not shown). While there were differences between the 2 cohorts in terms of race and gender, we did not correct the outcomes using logistic regression for these variables since it was unlikely that such differences would be clinically meaningful.

The percentage of patients who experienced hypoglycemia in the OR was small and not different between groups, nor was there any difference in the percentage of patients who experienced low BG within 24 hours of surgery. There was no difference in the rate of hypoglycemia (percentage of all BG values) in the 24 hours after surgery between the two groups. There was a decrease in overall rates of BG <70 mg/dL during the hospital stay in the intervention group (1.91% compared to 2.40% in the control group, $p<0.001$). The patient daily glucose levels during the entire hospital stay was similar between the groups. Rates of coded wound infection after surgery were too low to allow comparison (8 out of 818 patients). There was no significant difference in LOS, readmission or mortality between the two groups.

Discussion

Here we describe the three year outcomes from a standardized perioperative glycemic management program in patients with diabetes that indicate improved postoperative glycemic profiles when compared with unexposed historical controls. We found that the protocolized use of patient-tailored intravenous insulin followed by transition to subcutaneous insulin provided a modest reduction in post-operative hyperglycemia without increasing perioperative hypoglycemia, and may reduce hypoglycemia during the hospital stay.

There are few studies specifically addressing the effects of intraoperative hyperglycemia and most published work focuses on cardiac surgical patients. Ghadhi et al. showed that initial glucose level, mean and maximal intraoperative BG concentrations were significantly associated with postoperative complications in patients undergoing cardiac surgery (13). Logistic regression analysis indicated that for every 20 mg/dL increase in mean intraoperative BG, there was an increase of 30% in complications. The same group followed up with a randomized controlled trial in cardiac surgery patients, randomizing patients to IV insulin with a glucose target of 80-100 mg/dL vs insulin therapy only if glucose level was >200 mg/dL (14). They did not find a benefit for intensive intraoperative glycemic control and noted a higher rate of stroke in the intensive group. Ouattera et al. noted that poor intraoperative BG control (>4 consecutive BG >200 mg/dL) was associated with poor cardiac and non-cardiac outcomes in patients undergoing cardiac surgery (15). The lack of prospective data specifically addressing the intraoperative period has led many providers to use data from studies in critically ill patients that have indicated a benefit in moderate glycemic control (140-180 mg/dL) as a potential guideline. Our group implemented a BG target of 120-180 mg/dL in the OR based on the best literature available at the time of program development (2008). The BG target range was also the same range used in our intensive care units thus was comfortable for most providers. However the optimal BG target in the OR remains to be determined. Some studies have indicated that certain patient groups, such as those without prior diabetes, may have benefit from different BG target ranges and this merits further study (16).

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This study provides a real-word description of the implementation of a multidisciplinary glycemic protocol with glycemic outcomes in patients presenting for routine surgical procedures. Of note our protocol was mainly directed at controlling hyperglycemia while the patient was in the OR. However as part of the overall comprehensive management strategy the protocol called for patients to receive a consultation by the inpatient diabetes consult service in the PACU. The intention of this was to provide a transition to subcutaneous insulin from the infusion and thus mitigate rebound hyperglycemia. It is likely that this combined approach led to the modest improvement in BG levels both intraoperatively and in the 24 hours following surgery. The reduction in perioperative BG levels was not associated with any increase in short-term hypoglycemia. While we did not find any difference in the mean hospital glucose level between groups, the overall rate of hypoglycemia in the intervention group was lower as was the percentage of patients with a BG >200 mg/dL in the first 24 hours.. As the intervention was not randomized we cannot determine with certainty if factors other than the protocol influenced the change in glycemic outcomes.

Despite the comprehensive approach including IV insulin and transition to subcutaneous insulin in the PACU, the reduction in absolute BG levels was modest and the clinical significance unclear. However prior study has demonstrated an increased risk of postoperative infection associated with a BG level of >220 mg/dL on postoperative day 1 (6). We suspect that the limited improvement we saw in BG levels overall is due to several factors. As the average intraoperative time was approximately three hours, there was limited time to see the efficacy of the infusion. For the postoperative control, our experience matches with other published reports that show that scheduled subcutaneous insulin does not reliably bring patients with poorly controlled diabetes into target glucose range within 24 hours (17). Umpierrez et al performed a randomized trial comparing basal-bolus insulin vs sliding scale in postoperative surgery patients, and demonstrated a lowering in mean hospital glucose of 157 mg/dL vs 176 mg/dL (18). That study showed an improvement in clinical outcomes as well as glycemic measures. Our practice did not yield as much of a reduction in BG levels, and while the reasons are unclear there are several possibilities, including less aggressive dosing or titration of insulin, a non-selected patient population, or differences due to the application in routine care outside of a study setting. Though we found only a modest lowering in BG levels and the clinical significance is unknown, we do not anticipate a substantial change to our practice until a more effective strategy is determined.

Our study has several limitations. First, it was not a randomized trial but a post-intervention comparison to a historical control group. Thus we cannot be sure that the reductions we noted in postoperative glucose levels are solely attributed to the protocol. It is possible that other unmeasured factors affected perioperative glycemia, such as change in surgical technique or the use of intravenous antibiotics in dextrose; however we would not expect those to be different between the groups. We attempted to correct for baseline clinical factors that could have affected the outcomes, including the difference in the CCI and a trend toward a higher preoperative BG level in the control group. We found that the majority of our results continued to remain significant with the exception of mean intraoperative BG level, which would not be unexpected as this would be the closest metric to preoperative BG level. Furthermore, we were limited in obtaining a control group as prior to protocol implementation there was no standard procedure to check glucose levels, and thus a much smaller percentage of patients had blood glucose levels available for analysis. We do not know what prompted a preoperative glucose check prior to the protocol becoming standard, and whether this selected for a

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non-representative subset of patients. It is possible, for example, that there was some selection bias in the control group that may explain the higher mean preoperative glucose level seen in this cohort. Also, while the protocol was implemented hospital-wide and in our experience it was regularly followed, we were not able to determine protocol adherence for individual patients for the intervention group. We used coding to determine the rates of postoperative wound infection, and based on the number of coded wound infections we believe it was likely substantially undercoded and therefore were not able to make any conclusions regarding the effects the protocol may have had on this outcome. Finally, we did not analyze the doses of subcutaneous insulin administered in the PACU. While our general approach of weight-based insulin was consistent during the intervention, subcutaneous insulin dosing decisions were tailored to the patient and since they were not determined by a strict protocol we chose not to further analyze doses given.

We did not perform a formal cost analysis of our program. However, as mentioned previously there was no requirement to hire additional staff. Our perspective is that some of the costs surrounding this program were from added infrastructure (glucose meters) that were already necessary to ensure safe insulin practice in the perioperative areas given that insulin was already being used albeit subcutaneous insulin and without a protocol. The investments linked directly to the protocol may include increased nursing time at the bedside, increased use of glucose meter strips, and increased endocrinology consultative time. However, given the significant benefits of perioperative insulin therapy and glucose control shown in randomized trials in cardiothoracic surgery, and in retrospective analyses in general surgery patients, our method is likely cost-effective.

Although not specifically evaluated in our analysis, we expect that the number of surgical cases cancelled due to glucose level has been reduced through this protocol. Unfortunately, however, we were unable to assess rates of surgical cancellation for hyperglycemia in either group, due to the fact that the reason for cancellation was not generally documented in the EHR. There is no evidenced-based data to guide the decision as to when a procedure should be cancelled for hyperglycemia, and we feel this question is best addressed on an individual patient basis in conjunction with the surgeon and anesthesiologist. Issues to consider are the urgency and indication for the surgery, the patients' diabetes history, and the risks of the surgery and postoperative complications. We recommend checking for metabolic stability if the BG is >300 mg/dL preoperative and proceeding at the discretion of the surgical team. Of importance, we found that most patients who presented for surgery with hyperglycemia had elevated A1c values, indicating chronic poor glycemic control. It is unknown whether intervening to improve glycemic control preoperatively affects postoperative outcomes, although this hypothesis is being tested (19).

In conclusion, we found that following the implementation of a perioperative glycemic control protocol for patients with diabetes presenting for surgery there was reduction in BG levels in the perioperative time period with no increased rates of hypoglycemia. Further research is needed to define optimal targets and management strategies for hyperglycemic patients in the perioperative period.

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Figure 1a. Perioperative Diabetes Management Triage:
For Procedures > 1 hour

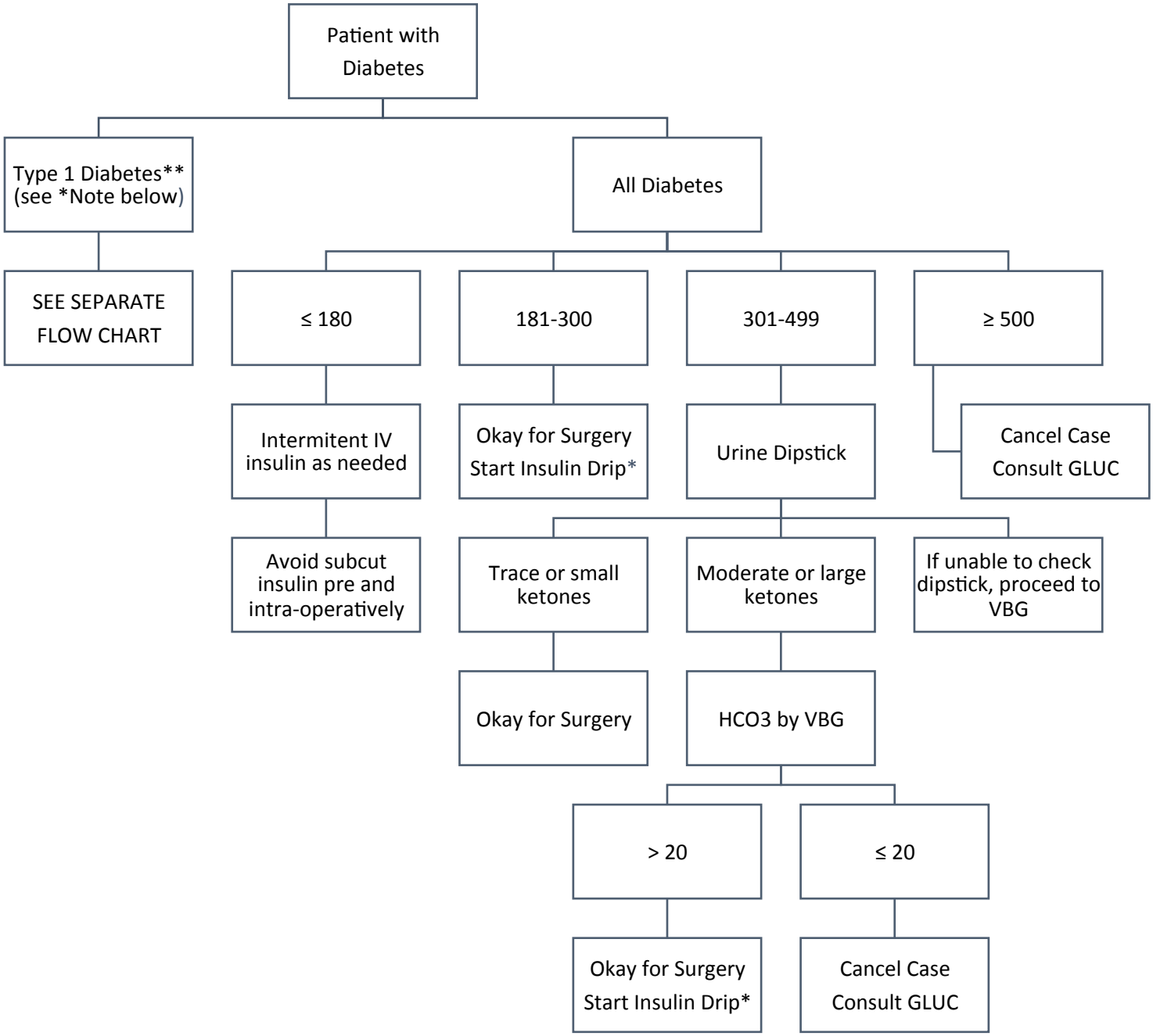


Figure 1b. Perioperative Diabetes Management:
Type 1 Diabetes and Procedures > 1 hour

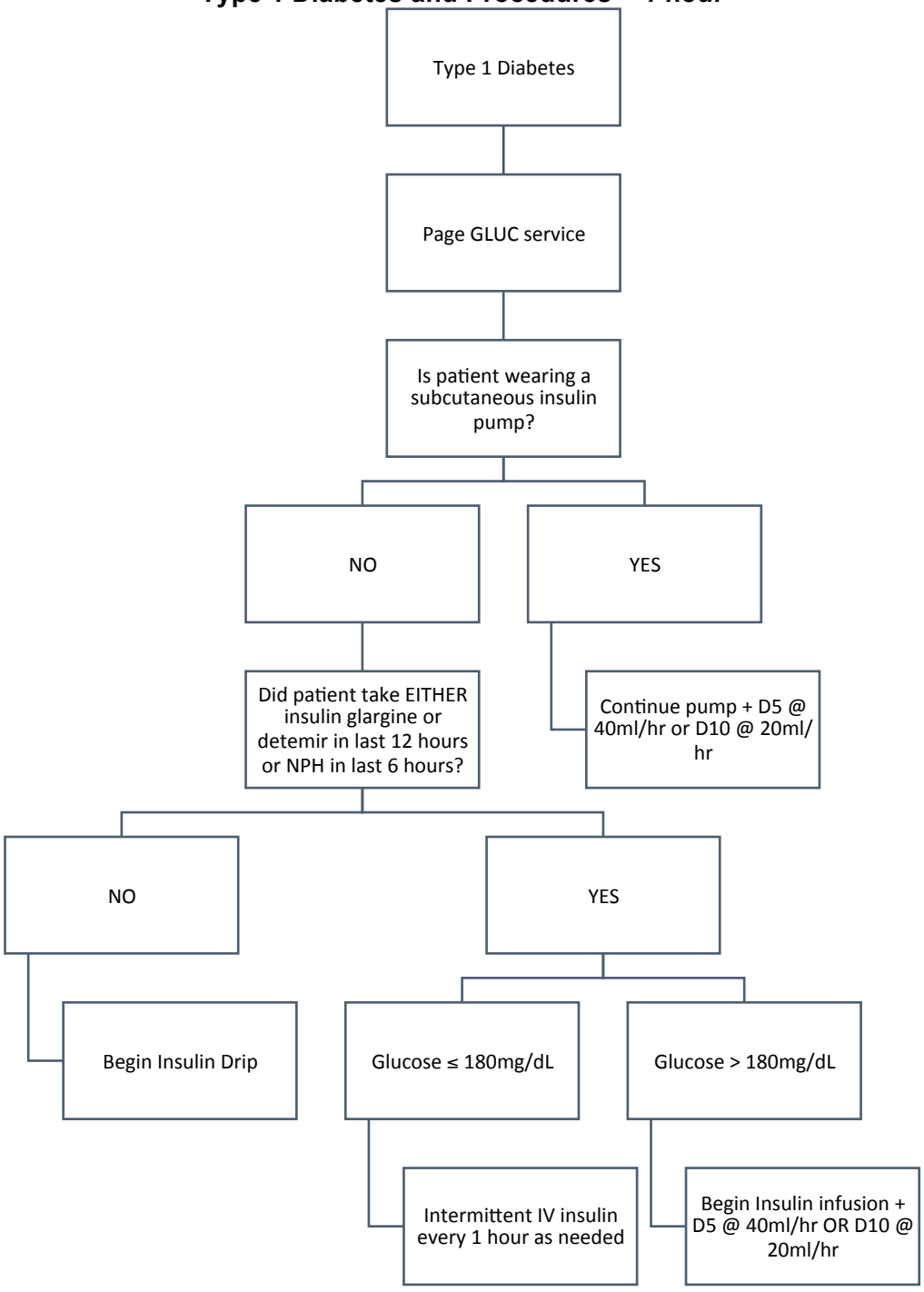
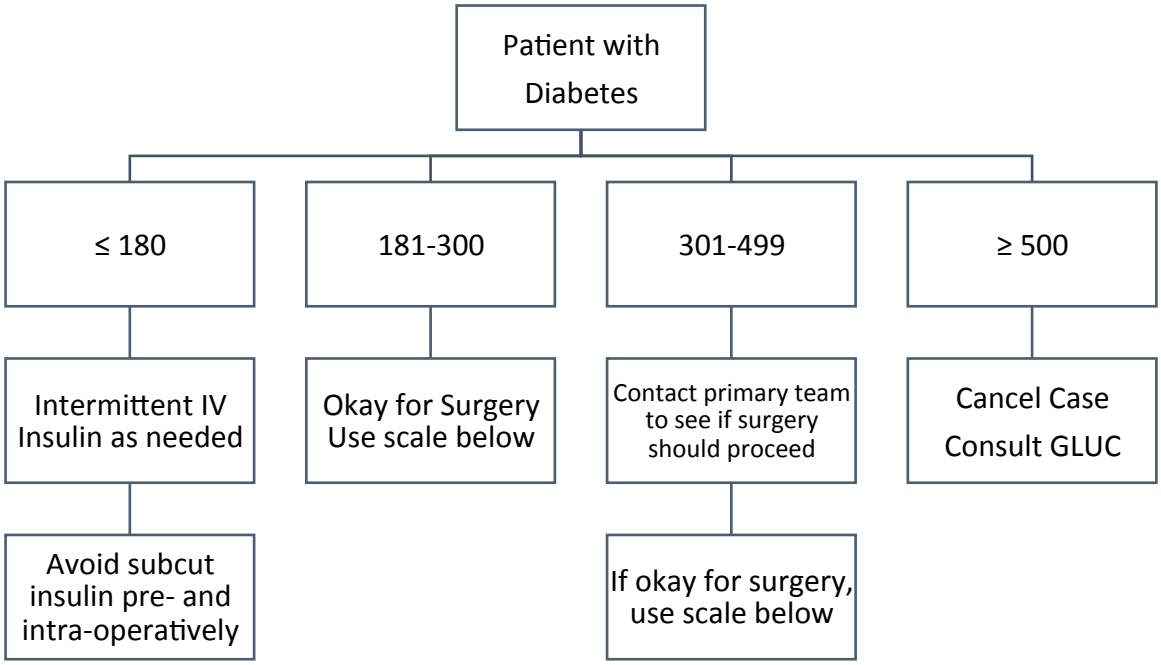


Figure 1c. Perioperative Diabetes Management:
ONLY for patients undergoing a procedure
Scheduled for ≤ *1 hour*



IV Regular Insulin Sliding Scale: Use as needed q 1 hour for a glucose >180 mg/dL
Check glucose 1 hour after giving IV insulin.

Blood Glucose	Regular Insulin IV Push
≤ 180 mg/dL	0
181 – 230 mg/dL	2 units
231 – 280 mg/dL	3 units
281 – 330 mg/dL	4 units
331 – 499 mg/dL	5 units
>499 mg/dL	Call Physician

Table 1: Patient Characteristics

Characteristic	Historical Cohort (n=260)	Intervention Cohort (n=558)
Age, years	57.8 ± 14.3	57.1 ± 14.6
Male (n, %)*	117 (45.0)	298 (53.4)
Hemoglobin A1c[+]	9.36 ± 2.58	8.98 ± 2.08
Charleson Comorbidity Index*	2.94 ± 2.8	3.58 ± 2.8
BMI (kg/m^2)	32.0 ± 9.63	32.29 ± 8.40
Creatinine (mg/dL)	1.39 ± 1.58	1.39 ± 1.45
Race (n, %)*		
White	123 (47.3)	226 (40.5)
Black	97 (37.3)	198 (35.5)
Hispanic	27 (10.4)	95 (17.0)
Other	13 (5.0)	39 (6.9)

*$p<0.05$, all other comparisons were not statistically different between groups.

[+] Only 89 patients in the control group and 216 patients in the intervention group had an available A1c.

Table 2: Glycemic and Clinical Outcomes

	Control (N)	Intervention (N)	P value
Mean (± SD) duration of surgery in minutes	189.7 ±1 118.4 (247)	183.5 ± 117.1 (546)	0.49
Mean preoperative glucose	229.8 ± 54.4 (260)	224.7 ± 48.0 (558)	0.1976
Mean glucose on arrival in the PACU	194.9 ± 68.2 (252)	182.4 ± 57.6 (549)	**0.0119**
Mean intraoperative BG	192.4 ± 61.0 (108)	176.5± 49.5 (307)	**0.0152**
OR glucose variability	30.39 mg/dL	26.22 mg/dL	0.2478
Mean number of BG per patient in OR	2.17 ± 1.51	2.58 ± 1.81	**0.0016**
Percentage of BG values >200 mg/dL within 24 hours after surgery	38.7%	32.8%	**0.0122**
Percentage of patients who experienced BG <70 during the hospital stay	83 (31.9%)	150 (25.2%)	0.39731
Percentage of patients who experienced BG <70 in the OR	3 (1.2%)	15 (2.6%)	0.31728
Percentage of BG values <70 mg/dL within 24 hours after surgery	2.69%	2.24%	0.4926
Mean BG within 24 hours after surgery	190.5 ± 50.7 (253)	182.1 ± 44.0 (550)	**0.0232**
Mean hospital glucose (patient-day)	175.4 ± 39.5 (260)	175.8 ± 34.5 (558)	0.8933
Hospital rate of hypoglycemia (% of BG values <70 mg/dL)	2.40%	1.91%	**0.0005**
Length of Stay (days)	7.59 ± 8.18 (259)	6.73 ± 8.27 (555)	0.1659

30-day Readmission (n, %)	11 (4.25)	32 (5.75)	0.3727
Hospital Mortality	14 (5.38)	18 (3.23)	0.1381

PACU = postoperative care unit. BG = blood glucose.