ORIGINAL ARTICLES

Preoperative Diabetes Management Protocol for Adult Outpatients

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The lack of evidence-based guidelines or nationally recognized protocols for the preoperative management of adult diabetics in the outpatient setting poses a challenge for the perianesthesia practitioner. The West Virginia University Hospital Perioperative Research Committee sought to develop an institutional protocol for management of this population. A retrospective chart review of diabetic outpatients who arrived the morning of surgery with elevated glucose levels was performed. The purpose of the chart review was to delineate indicators measured in the preoperative visit that could be predictive of patients arriving the morning of surgery with an elevated glucose level. Self-reported home fingerstick glucose values >200mg/dL were a statistically significant ($p = .007$) indicator of elevated arrival glucose in the preoperative holding area. Results of the chart review and best clinical evidence, as well as expert opinion, were used to develop an Adult Preoperative Diabetes Protocol and an accompanying Patient Instruction Tool.

Keywords: *ambulatory surgery, diabetes, glucose control, protocol development, outpatient surgery.*

MOUNTING evidence supports careful management of glucose during the perioperative period for diabetics undergoing surgical procedures. The Joint Commission recognizes hospitals that make exceptional efforts to foster better outcomes in diabetic patients.[1] Fifteen to 20% of surgical patients in the United States have diabetes mellitus.[2] Many of these patients are not hospitalized preoperatively and arrive the morning of surgery to undergo their procedure. Fifty-two percent of surgical visits in 2003 were ambulatory. As of 2003, more than 4.9 million surgeries were performed annually in American ambulatory surgery centers.[3] Management of diet and medications preoperatively toward optimal glycemic control for this large group of diabetic outpatients is a challenge to the preoperative healthcare providers and the patient.

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The target glucose goal for diabetic outpatients arriving the morning of surgery is unknown. It is unclear if arriving the morning of surgery with an elevated glucose level is an independent risk factor for morbidity and mortality. Studies have focused on aggressive glucose control during the surgical and postoperative period.[2,4-6] Optimal glycemic control has been shown to improve morbidity and mortality in surgical and intensive care patients. Benefits of glucose control include improved wound healing, decreased episodes of infections, and shortened length of stay (LOS).[4] Van den Berghe, et al[5] demonstrated decreased infection, transfusions, and episodes of acute renal failure in critically ill patients controlled to glucose of 80–110 mg/dL. There remains, however, concern over the possibility of negative outcomes related to low glucose levels during this period. Gandhi and colleagues[6] recently found an increased incidence of stroke and death in a group of patients treated with intensive glucose management during cardiac surgery compared with patients in the conventional treatment group.

There are no prospective, randomized trials focusing on the management of diabetic patients in the preoperative setting. It is unclear what, if any, indicators exist preoperatively that can predict patients who will arrive the morning of surgery with elevated glucose levels. Nor are there any nationally recognized guidelines of outpatient preoperative management of glucose for patients having ambulatory surgery or being admitted the morning of surgery for more extensive procedures. There is also no generally accepted guideline for the treatment of hypoglycemia in the outpatient diabetic patient who is "nothing-by-mouth" (NPO) the morning of surgery. In addition, there appears to be confusion and inconsistency between and within surgical centers concerning the management of diabetic patients during the preoperative period.

Purpose

The purpose of this article is to report a retrospective chart review of factors that could be identified during the preoperative visit that may be predictive of patients arriving the morning of surgery with an elevated glucose level. The second purpose is to describe a preoperative Adult Diabetes Management Protocol and Patient Education Tool that was developed as a result of the chart review.

Procedure

This retrospective chart review was conducted for the purposes of quality improvement, and thus not considered human subject research by our institution; therefore, Institutional Review Board approval was not required. Charts of 525 consecutively scheduled adult patients undergoing an outpatient preoperative visit in April 2006 before undergoing surgery at West Virginia University Hospital (WVUH) were reviewed to identify patients with a diagnosis of diabetes. Forty-seven patients were identified. These charts were then reviewed by the author (M.P.) with an audit of 20% of the diabetic charts performed by a perioperative RN. Criteria for inclusion were defined as any patient requiring medications for diabetes management at home before surgery. Demographic data including age, gender, height, and weight were obtained. Diagnosis, surgical service, and type of operation were also noted. Data regarding diabetic medications and preoperative medication instructions was reviewed. Patients self-reported finger stick averages and arriving finger stick values were documented. Elevated glucose on arrival was defined as arrival fingerstick glucose of 200mg/dL or greater in the preoperative holding area. Statistical analysis was performed.

Results of Chart Review

Forty-seven charts were reviewed, with results reported in Table 1. There were 24 males (51%)

Table 1. Characteristics of the Diabetic Sample

	Mean	Range	Standard Deviation
Age (years)	59.5	28–83	11.75
Weight (kg)	104.4	52–216	37.9
Body mass index (kg/m^2)	35.8	20–69	11.21
Arrival fingerstick glucose (mg/dL)	161	70–420	66.8

and 23 females (49%), with a mean age of 59.5 years and a mean BMI of 35.8 kg/m^2. The mean arrival fingerstick value was 161 mg/dL, with a range of 70–420 mg/dL (Table 1).

Pearson correlations demonstrated no significant relationship between age and arrival fingerstick (P = .214), weight and arrival fingerstick (P = .715), height and arrival fingerstick (P = .577), and BMI and arrival fingerstick (P = .786). Table 2 illustrates the number of patients taking oral diabetic medications versus insulin. *T*-test results showed no significant differences in the mean glucose levels between the patients taking oral medication and those taking insulin (155 vs 190, respectively, P = 0.16). When the group of patients taking oral medication alone was combined with the group of patients taking oral medications and insulin, the *t*-test of the mean of that cohort compared with the mean of the group of patients taking insulin only was also not significantly different (153 vs 190, P = .329).

As illustrated in Table 3, seven patients had an arrival glucose of ≥200 mg/dL (mean 282).

Table 2. Number of Patients on Oral Meds vs. Insulin

Medications	Number	%
Oral diabetic medications only	30	64
Insulin only	11	23
Oral medications and insulin	6	13

Table 3. Fingerstick Glucose Values—Home Report vs. Arrival

Reported FS values at home (mg/dL)	No. of patients	Mean arrival finger stick
70–120	13	137
121–150	8	145
151–200	8	131
>200	7	282
Did not check	4	154
Not reported	7	144

One-hundred percent of those patients at home reported fingerstick readings >200 mg/dL. The mean arrival glucose of the remaining 40 patients (85%) was 141 mg/dL. The difference between these means (141 vs 282, respectively) was statistically significant (P = .007), suggesting that patients' self-report of home fingerstick values >200 mg/dL may be predictive of arrival fingerstick glucose >200 mg/dL. The results of this retrospective chart review were considered in the formulation of the preoperative diabetes protocol and plan of care for diabetic outpatients awaiting surgery.

Preoperative Standards of Practice

Considerations for the patient with diabetes in the preoperative setting include diet, medications, level of diabetes control, and preexisting diabetic complications. Diabetic patients have traditionally been kept NPO for at least eight hours preoperatively because delayed gastric emptying may put diabetic patients at greater risk for vomiting and aspiration. Some sources recommend diabetic patients remain NPO for more than one day for abdominal procedures.[7]

Management of medications in the preoperative period can be problematic if patients must travel a long distance the morning of surgery, or if surgery is not scheduled early in the morning. Tight glycemic control, without a hypoglycemic reaction, is the current goal.

The former standard of practice was to give patients who require insulin half of their usual dose of insulin the morning of surgery. Oral hypoglycemic medications were typically withheld the morning of surgery. It was presumed that patients who would be NPO would require fewer diabetic medications. High glucose levels were tolerated the morning of surgery because health care professionals felt it was better to tolerate high glucose levels in the perioperative period than to risk hypoglycemic sequela. For example, Fetchick and Fischer[8] recommended no treatment for an arriving glucose value < 250 mg/dL. The authors commented that, "Elevated blood glucose prior to surgery will often improve with correction of the condition requiring surgery."

Current Strategies

Hoogwerf[7] discusses the limited evidence for management of diabetic patients in the preoperative setting, describing the current strategy for the insulin-dependent patient as a regimen designed to mimic physiologic insulin secretion, with a preoperative glucose goal of < 200 mg/dL. The relatively recent attention to the achievement of optimal glucose levels in the perioperative period has led clinicians to seek interventions that normalize glucose during this period, without placing an unreasonable burden on the patient care providers or patients. Hoogwerf[7] recommends a basal plus a calorie-stimulated bolus of insulin based on his experience at The Cleveland Clinic. This is accomplished by giving one-half to two-thirds of the patient's usual insulin dose in the form of intermediate-acting insulin the evening before and the morning of surgery, with the option to give a full dose. In addition, patients may take sliding scale short-acting insulin coverage the morning of surgery. The recent addition of the insulin glargine (Lantus Insulin) has led some practitioners to recommend giving half of that dose preoperatively, whereas others recommend taking the full dose based on glargine's reported action on basal glucose only. Confusion exists over the management of patients on insulin pumps and with multiple sliding scale coverage schemes.

Oral diabetic medications such as sulfonylureas and biguanides should be withheld the morning of surgery. Metformin may be held an additional day before surgery in patients with dietary restrictions, or a bowel prep because of the possibility of dehydration and possible lactic acidosis. Most practitioners withhold thiazolidinediones, although they are not insulin-stimulating medications. Oral antiglycemic medications are rarely administered the morning of surgery in noninsulin-dependent diabetic patients who arrive for surgery with an elevated glucose level and are anticipated to have a short surgery with intake of food shortly thereafter.

Pathophysiology of Diabetes for the Surgical Patient

A practitioner's understanding of the pathophysiology of hyperglycemia and the stress response is essential to the management of diabetic patients in the perianesthesia period. Hyperglycemic patients are at risk for many perioperative complications. Hyperglycemia may predispose patients to fluid and electrolyte imbalance. In addition, the intravenous infusion of insulin and glucose may predispose patients to hypokalemia. Patients with elevated glucose levels may also have decreased immune functioning because of decreased mobility and phagocytic functioning of white blood cells. Immunoglobulins have decreased functioning when glycosolated, or "sugar coated," from circulating in plasma with a high concentration of sugar. The known microvascular, macrovascular, and neuropathic complications of diabetes compound these problems.[9]

The Process of Protocol Development

The authors were surprised to find a lack of clinical indicators, other than self-reported glucose, to guide protocol development. Armed with the above information, the authors

engaged a multidisciplinary team in the creation of an Adult Preoperative Diabetes Management Protocol and Preoperative Diabetic Instruction Sheet (see Appendices 1 and 2). Members of the team included the Director of Perioperative Services, the Physician Director of the Preoperative Unit (an Anesthesiologist), the WVUH Vice President for Quality and Patient Safety, an Endocrinologist, and one of the authors (a Nurse Practitioner). The author (M.P.) created a draft protocol that was disseminated to the group and critiqued by each team member. Because all team members did not completely agree on every aspect of the protocol, the team concluded that when developing a practice protocol based on limited evidence, all participants may not fully agree on each aspect, but the best evidence and clinical judgment should be used to develop a safe, effective, quality tool to help promote the best patient outcomes.

The following month, the revised protocol was reviewed and shared with the anesthesia faculty by the Physician Director of the Preoperative Unit. Revisions were made and the protocol was re-reviewed and approved by the team. An accompanying Instruction Sheet to be given to the patient was also developed and approved by the team. The documents were reviewed to assure medical literacy. The final protocol (Appendix 1) and instruction sheet (Appendix 2) were disseminated to the hospital staff. This information and documents were shared with the surgical chairs, physicians, and residents via an email communication. Individual emails were sent to key practitioners in the Medical Group Practice who regularly performed preoperative evaluations. The author (M.P.), a Family Nurse Practitioner in the Preadmission Unit, shared the information with the Preoperative Nurse Practitioners and Nursing Staff. Individual instruction was given to each Nurse Practitioner, and the documents were posted on the appropriate educational bulletin board for nursing review. Hard copies of the documents were made readily available in the Preadmission Unit. This entire process of protocol development and communication to all affected parties took about three months.

Discussion

The success of the chart review, protocol development, and dissemination of the new guideline was made possible by involving many stakeholders in the process. The administrative, medical, and nursing staffs saw benefit to this project and were eager to participate. Patients and health care providers now have written guidelines for the management of diabetic medications on the morning of outpatient surgery. The authors expect implementation of the guideline and educational instrument to translate into improved arrival glucose values for surgical patients. Decreasing the number of cancelled surgeries because of high arrival glucose will improve both staff and patient satisfaction.

Limitations

The Perioperative Research Committee and the multidisciplinary committee acknowledge that this protocol is based on a limited chart review and limited evidence. The small number and retrospective nature of our chart review limit the applicability of the results. Factors not statistically significant in our review may have proven significant with a larger sample size. The lack of research on this subject limits our ability to create a scientifically-based protocol for the management of adult diabetic patients before arrival for surgery. Despite these limitations, a protocol and accompanying teaching document were created using the best evidence available, including experts in our institution. A follow-up chart review to assess the impact on arrival fingerstick values of this protocol and instruction implementation will need to be done to assess the effectiveness of the intervention.

Conclusion

Evidenced-based guidance on the perioperative management of diabetic patients is still limited.

Self-reported home glucose values >200 mg/dL may be indicative of a patient who will arrive the morning of surgery with a fasting fingerstick glucose value >200 mg/dL. Individualizing preoperative diabetes care by using a standardized adult diabetic preoperative protocol and patient instruction tool may have an impact on glycemic control and sequela in the perioperative period. Using a multidisciplinary approach to developing protocols and guidelines in this setting is effective. The Joint Commission's Certificate of Distinction for Inpatient Diabetes Care recognizes hospitals that make exceptional efforts such as these to foster better outcomes in the inpatient setting. Practitioners participating in the perioperative management of diabetics must continue to monitor the literature for recommended changes in the care of these patients. More research is needed on the perianesthesia management of diabetic patients to achieve optimal glucose management and outcomes. Targets for arrival glucose values should be explored along with their impact on the perioperative/perianesthesia course.

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Appendix 1. Diabetic Instructions for Your Surgery

Do not eat or drink anything after midnight the night before your surgery.
The **night before surgery** take these diabetic medications:
Insulin:
Pills:
The **morning of surgery** do not take your long-acting insulin or diabetic pills. Check a fingerstick when you wake up. If you have rapid-acting insulin (regular, Lispro, Humalog, Aspart, and Novalog), use the following coverage scale:
Fingerstick less than 200 – No insulin
Fingerstick 201-250 – 2 units of rapid-acting insulin
Fingerstick 251-300 – 4 units of rapid-acting insulin
Fingerstick more than 300 – 6 units of rapid-acting insulin
If you are unsure what to do the morning of surgery, you may call the OR at 124-456-7890 after 7 AM and ask to speak to the Anesthesiologist who will be taking care of you that day. They will help you decide how much insulin to take.
If you have a **low sugar** episode the morning of surgery, put granulated sugar inside your lip or cheek and let it dissolve, or take your glucagon shot.
Additional instructions: *Bring your medications with you the morning of surgery*
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Appendix 2. Instructions for Adult Diabetic Patients Seen in the Outpatient Preadmission Setting Before Surgery

1. The interview of the diabetic patient in the outpatient preadmission visit will include soliciting a list of the current medications for diabetes including dosage and frequency. Patients will be asked what their fingerstick readings have ranged for the past two weeks. If a patient is aware of the most recent HbA1C, that may be documented. A fingerstick glucose value on arrival the morning of surgery should be ordered by the Preadmission Practitioner.
2. All diabetic patients will be instructed to be NPO after midnight because of possible gastroparesis and aspiration risk.
3. If the patient is NPO before the procedure and/or receiving clear liquids for 24 hours before procedure with prep, hold all insulin-stimulating medications (sulfonylureas and meglitinides) during the prep and the morning of the procedure because of the risk of hypoglycemia.
4. If the patient is taking metformin (Glucophage), metformin should be withheld for the duration of the prep and throughout the procedure because of the risk of dehydration and lactic acidosis.
5. If the patient is taking pioglitazone (Actos) or rosiglitazone (Avandia), they may be continued throughout prep and procedure.
6. If the patient is taking insulin, **during prep and the night before the procedure**, reduce Lantus by 50% or reduce NPH by 50%. Hold rapid-acting insulin (Regular, Lispro, Humalog, Aspart, and Novalog). Blood sugars should be monitored every four hours during prep, and the patient should cover blood sugars that are >200. The sliding scale presented below may be used as a guide.

Blood sugar 61-200 – No Insulin
Blood sugar 201-250 – 2 U rapid-acting insulin
Blood sugar 251-300 4 U rapid-acting insulin
Blood sugar >300 6 U rapid-acting insulin

7. Patients should be instructed to hold all long-acting insulin **the morning of surgery**. They should check fingerstick

glucose upon awakening and use the previous scale for coverage. If patients have questions regarding their glucose management the morning of surgery, they may call 123-456-7890 after 7 AM on the morning of surgery and ask to speak to the anesthesiologist who will be taking care of them that day.

If a patient is on an insulin pump, the basal rate of the pump should be reduced by 25% per hour after midnight. No boluses are given unless blood sugar is >200 mg/dL. Blood sugars should be monitored every four hours while the patient is awake. Coverage should be done with 2 U for blood sugar >200. If blood sugar remains elevated, increase doses of basal coverage to prevent severe hyperglycemia.

8. Patients should be instructed to manage symptomatic hypoglycemia the morning of surgery by using Glucagon or buccal glucose (granulated sugar placed inside lip or cheek).
9. Upon arrival in the preoperative anesthesia setting the morning of surgery, patients with known diabetes should have a fingerstick blood sugar checked at the time of admission. A diet and medication history should be acquired for the last 48 hours as it relates to hypoglycemic oral medications or insulin.
10. Modification of this protocol to specific patient needs will sometimes be necessary. The practitioner may individualize recommendations as deemed appropriate.

Metaglitinides- repaglinide (Prandin), nateglinide (Starlix)
Sulfonylureas – glipizide (Glucotrol), glyburide (Micronase, Diabeta, Glynase), glimepride (Amaryl)

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