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Perioperative Glucose Control in Patients With Diabetes Undergoing Elective Surgery

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Hyperglycemia in the perioperative period is associated with several adverse outcomes including wound infection, pneumonia, sepsis, and cardiovascular events.[1] Limited evidence suggests that good glucose control is likely to be beneficial in reducing postoperative mortality, length of hospital stay, and cardiovascular complications such as stroke.[2] Guidelines for achieving good perioperative glucose control are available but lack sufficient detail.[3] In this JAMA Insights article, we outline an easy-to-adopt approach for safe and effective perioperative management of hyperglycemia.

Preoperative Assessment

Hemoglobin A_{1c} (HbA_{1c}) should be checked preoperatively in all patients with diabetes to assess glucose control. Although higher levels are associated with unfavorable outcomes, no evidence shows that postponing surgery to improve glucose control is beneficial. Perioperative glucose levels have been shown to influence surgical outcomes more than HbA_{1c}.[4] However, it is reasonable to defer elective surgery in patients with HbA_{1c} above 8% if the situation will intensify diabetes management strategies. Severe hyperglycemia (glucose >250 mg/dL), with or without metabolic decompensation, warrants postponement of elective surgery.

During the preoperative evaluation of patients with diabetes, it is important to review current glycemic control and pharmacotherapy and provide the patient with written instructions on how to adjust medications the day before and the morning of surgery. In general, on the day before surgery, patients can continue all medications including metformin. Concerns about metformin-induced lactic acidosis or other adverse effects, when this drug is administered before surgery, are largely unfounded.[5] The only medication that may need dose adjustment the day before surgery is long-acting basal insulin administered at night. If patients take inappropriately high doses of basal insulin (>60% of total daily dose of insulin), predisposing to hypoglycemia during a prolonged fast, the dose should be reduced by 50% to 75%. This is especially relevant for patients with malnutrition or other concomitant illnesses such as renal and hepatic insufficiency, which increase the risk for hypoglycemia. A recent observational study in patients with type 2 diabetes indicated that the optimal basal insulin dose on the evening before surgery is about 75% of the normal dose.[6]

The **Figure** presents a possible approach for adjustment of insulin dose on the morning of surgery. Although not formally validated, this approach is used extensively at Mayo Clinic with good results. In patients with type 1 diabetes, it is important to not interrupt basal insulin delivery to prevent the occurrence of diabetic ketoacidosis. No adjustments in the dose of long-acting insulin are required if its current dose is appropriate (no hypoglycemia on prolonged fasting). In patients with type 2 diabetes, it is often reasonable to administer half the dose of basal insulin the morning of surgery. Similarly, the dose of intermediate-acting insulin should be reduced by half in all patients because it provides prandial coverage for the midday meal, which will likely be skipped on the day of surgery. All short-acting prandial insulin doses are stopped until the patient resumes oral food intake, as also are noninsulin antidiabetic agents. For patients treated with premixed insulin preparations who have satisfactory fasting blood glucose levels, half the basal component dose can be administered as intermediate-acting insulin (NPH). However, if patients have fasting hyperglycemia (>200 mg/dL), half the morning dose of premixed insulin can be administered before surgery.

When patients report for surgery in the morning, their blood glucose and time and dose of last diabetes medication should be recorded. Hypoglycemia (glucose <70 mg/dL) should be treated with glucose tablets or gel if food or drink is not allowed. For patients taking insulin or a sulfonylurea, it is desirable that blood glucose be greater than 100 mg/dL before the start of surgery. If blood glucose is greater than 180 mg/dL, a supplemental correction dose of rapid-acting insulin is often administered. Intravenous insulin infusion may need to be initiated in some conditions (eg, severe hyperglycemia or type 1 diabetes with prolonged surgery). A standard protocol for subcutaneous supplemental correction insulin dose and also for intravenous insulin infusion rates should be adopted.

To the extent possible, elective surgery for patients with diabetes should be scheduled early in the morning to help limit the duration of fasting. When this is unavoidable, basal insulin and supplemental correction insulin should be administered as outlined previously, and appropriate prandial coverage should also be provided if the patient is allowed to eat early in the day.

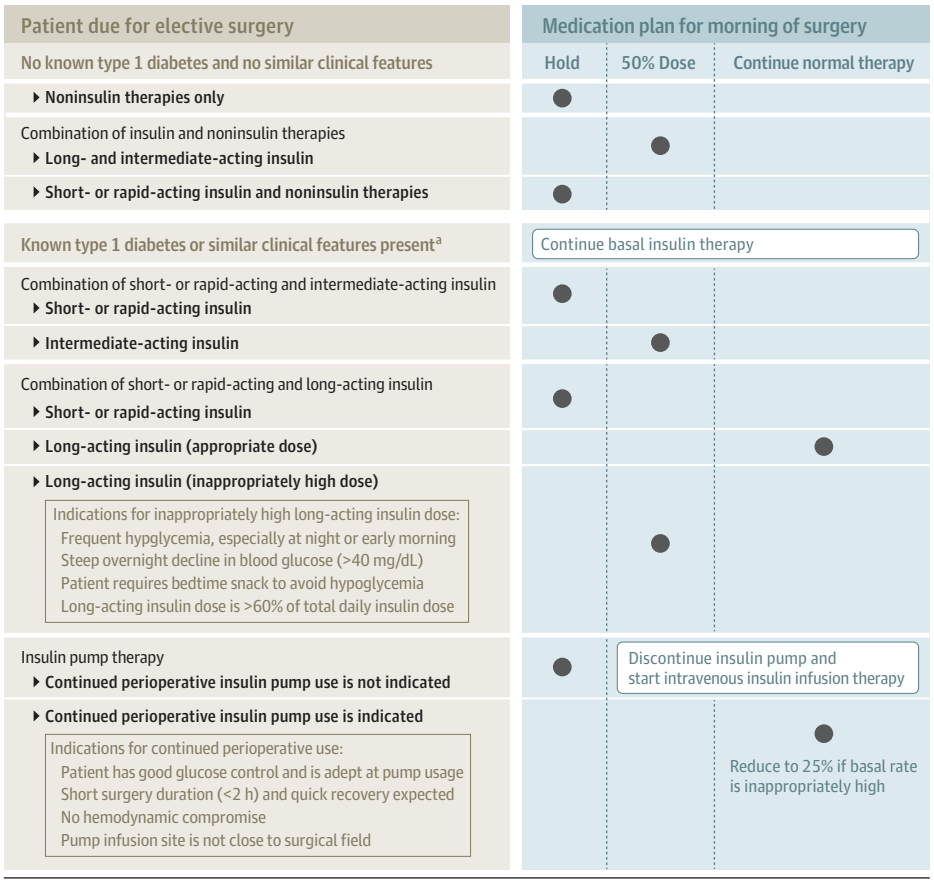
Intraoperative Glucose Management

Intraoperative hyperglycemia has been associated with a variety of undesirable surgical outcomes, but the benefits of stringent glucose control during this period are uncertain. A randomized trial of intensive insulin infusion therapy to maintain blood glucose in the normal range of 80 to 100 mg/dL was not found to favorably influence postoperative complications and may be associated with greater harm.[7] It is therefore advisable to maintain blood glucose less than 180 mg/dL without causing hypoglycemia. This can be achieved either by subcutaneous supplemental doses of rapid-acting insulin administered every 2 hours or by intravenous insulin infusion with blood glucose monitoring every 1 to 2 hours.

Postoperative Management

Upon arrival to the postoperative care area, blood glucose must be rechecked and intraoperative insulin administration reviewed. Intravenous insulin infusion should be continued in patients who received it intraoperatively and initiated if subcutaneous insulin injections have not been effective in controlling blood glucose levels. Intensive insulin therapy in the postoperative period has been associated with lesser risk of infection and overall morbidity and mortality, but ideal glucose targets are not clear. Based on studies in other hospitalized patients (both surgical and nonsurgical), it seems reasonable to target preprandial blood glucose between 100 and 140 mg/dL and random

Figure. Suggested Administration of Insulin and Other Diabetes Medications on the Morning of Surgery



Insulins by method of performance are categorized as long-acting (glargine, detemir, and degludec), intermediate-acting (NPH insulin), and short-acting (regular human insulin) insulins, and rapid-acting insulin analogues (insulin aspart, lispro, and glulisine).

[a] Examples of patient characteristics: needing multiple doses of insulin and if 1 dose of insulin is skipped, the next monitored glucose level is very high; small changes in insulin doses lead to big changes in glucose concentration; history of severe hyperglycemia or ketoacidosis without a major stress; high within-day glucose variability; recurrent hypoglycemic episodes; patients with postpancreatectomy diabetes.

blood glucose between 100 and 180 mg/dL. A basal-bolus regimen has been shown to be more effective than supplemental correction sliding-scale insulin alone in surgical patients[8] and should be adopted once patients resume oral nutrition.

Use of Insulin Pump in the Perioperative Period

Continuous subcutaneous insulin infusion through an insulin pump, with or without glucose sensor augmentation, is becoming increasingly popular and can be used to perioperatively deliver basal insulin in appropriate conditions (Figure). Use must be limited to patients capable of self-management who are undergoing a relatively short surgery. Basal rate reduction should be considered similar to adjustment of basal injection dose (as discussed previously). Few studies have examined the reliability of continuous glucose monitoring in hospitalized patients, and therefore, use in the perioperative period should be restricted only to research settings at this time.

Conclusions

Hyperglycemia represents significant risk to surgical patients, and effective management has the potential to improve surgical outcomes in patients with diabetes. A comprehensive program from preoperative evaluation through surgery and postoperative care and culminating in clear discharge instructions about diabetes medications is necessary to accomplish this goal.

ARTICLE INFORMATION

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