

PERIOPERATIVE DIABETES MANAGEMENT

Optimal glycemic control in the perioperative period decreases the infection rate and other complications. The goal is to prevent hyperglycemia, not just to react to it. The traditional practice of writing only for a “sliding scale” as well as the term “sliding scale” should be abandoned. Good glycemic control requires you to be proactive, not just reactive. Think in terms of **basal, prandial, and correction insulin** therapy.

The HbA1c level does not correlate well with operative outcomes and an elevated level should not be a reason to cancel surgery. (Note: the HbA1c may be inaccurate in hospitalized patients due to end-stage renal disease, erythropoietin, acute anemia, RBC transfusions, and hemoglobinopathies.)

Recommendations for Perioperative Use of Antidiabetic Medication (for procedures that require a restricted oral intake):

Non-insulin therapies:

Insulin secretagogues: glyburide, glipizide, glimepiride (Amaryl), repaglinide (Prandin), nateglinide (Starlix)	Do not take the morning of surgery. Restart postop when patient resumes eating.
Metformin (and combination drugs containing metformin)	Do not take the morning of surgery. Restart when patient is eating and renal function has been confirmed to be acceptable.*
TZDs (“glitazones”):** rosiglitazone (Avandia), pioglitazone (Actos)	Do not take the morning of surgery. Restart postop once patient resumes eating.
Newer therapies: -Incretins: exenatide (Byetta) -Dipeptidyl peptidase-4 inhibitors: sitagliptin (Januvia) -Amylin analogs: pramlintide	Do not take the morning of surgery. Restart postop once patient is eating and has no nausea.

*Generally considered a serum creatinine of 1.5 for men and 1.4 for women, although creatinine clearance is a better measure of renal function. This is only necessary if the procedure is likely to cause renal dysfunction, in which case verify acceptable renal function 48 hours after surgery, or IV contrast, before resuming metformin.

** Note Black Box warnings.

Endocrine

Insulin:

Understanding the terminology

BASAL insulin	Longer acting insulins, e.g. glargine (Lantus), detemir, and NPH, which provide a constant supply of “background” insulin, regardless of meals. All patients with Type 1 diabetes <i>require</i> this and many with Type 2 diabetes <i>need</i> this, especially in the perioperative period.
PRANDIAL insulin	The fixed dose of rapid acting insulin, e.g. lispro, aspart, glulisine, or regular, which is given before a meal to mimic the body’s normal response to a caloric load.
CORRECTION insulin (replaces the older term “sliding scale”)	The variable amount of insulin given <i>in addition to</i> the prandial and/or basal insulin to correct hyperglycemia. Correction insulin can also be given at bedtime.

Preop:

Patients need to continue BASAL insulin but withhold PRANDIAL insulin. Because basal insulin is frequently providing some prandial coverage, it is often necessary to reduce basal insulin by a percentage for NPO patients.

Basal insulin	NPH*	75% of usual evening dose the night before surgery. 50% of usual AM dose (if applicable) on the morning of surgery.
	Glargine (Lantus) Detemir (Levemir)	Take 50-75% of the usual evening dose (50% if patient takes more than 50 units normally). Take 50-75% of the usual morning dose (50% if the patient takes more than 50 units normally).†
	Premixed insulin (NPH/Reg 70/30 Humalog 75/25 or 50/50 mix, Novolog 70/30 mix)	Take 75% of usual evening dose. Take 50% of usual morning dose.
	Insulin pump	Discuss with diabetes provider. In general, continue basal rate then switch to D5NS plus insulin infusion just prior to surgery and stop the pump. Continue IV insulin until tolerating an adequate diet, then resume the pump if the patient is stable, alert, and able to manage the pump. Endocrinology consultation is recommended.
Prandial insulin	Short-acting insulin	Do not take on the morning of surgery with the exception of correction algorithms for hyperglycemia using rapid acting analogs—lispro (Humalog), aspart (Novolog), glulisine (Apidra).
		Note: Do not use regular insulin (U-100 and U-500) for correction due to prolonged duration of effect.

* has a peak and thus provides some prandial coverage.

† For patients who have classic type 1 diabetes mellitus, take no less than 75% (usually 80%) of the usual evening or AM dose—as always, discuss with the patient’s diabetes provider if necessary.

Postop: Transitioning from insulin infusion once patient is eating.

When to transition:

- The patient should be eating a reasonable amount of calories and have a reasonably stable blood sugar on the insulin infusion.
- Discontinue the infusion at mealtime and give the short acting prandial insulin per schedule. (For patients transitioning at bedtime, continue the infusion for two hours after the glargine, detemir, or NPH dose to compensate for the slower onset of the basal insulin.)

Calculating the dose:

- Calculate the amount of insulin given via infusion over the last **twelve** hours to give you the estimated **twenty-four** hour subcutaneous insulin requirement. (**Note:** the twenty-four hour subcutaneous dose is usually only a little more than half of the IV dose.) Using the amount of insulin given in the last twelve hours is more likely to predict the next twenty-four hour requirement.

Last 12 hours total IV dose = Next 24 hours total SC dose

Next, divide the 24 hour SC dose as follows:

- 50% of the estimated requirement is given as (basal) glargine, usually at bedtime.
- 50% of the estimated requirement is given as lispro or aspart as three equally divided mealtime (prandial) doses.

Example:

Your patient has required **3** units of insulin IV per hour **for the last twelve hours.**

$$3 \times 12 = 36 \text{ units total SC dose}$$



$\frac{1}{2} \times 36 = 18$ units of basal insulin
(e.g. glargine qhs)

$\frac{1}{2} \times 36 = 18$ units of prandial insulin
(e.g. lispro, aspart, glulisine divided before each meal)

$$18 \text{ units} / 3 = 6 \text{ units before each meal}$$

Modify the insulin dose by 20-30% every day until the patient has optimal glycemic control. Evaluate the blood glucose pattern to determine which insulin should be adjusted.

Note:

- If the infusion is stopped at breakfast or lunch, you can give a one-time dose of NPH (roughly half the dose of the planned evening glargine) to serve as a bridge to the first glargine dose that evening.
- If the patient is on steroids, give no more than 40% basal and at least 60% prandial.
- Consider using Regular insulin for prandial coverage (but not correction dose) for patients with gastroparesis.
- Glargine starts to work in about an hour and lasts 20-24 hrs in most patients with no pronounced peak. Sometimes dosed twice daily, especially in those with type 1 DM.
- Detemir is similar to glargine. It starts to act in about an hour and is "relatively flat" as far as any peak is concerned. Duration is variable but is up to 23 hours at usual doses. It is often given twice daily.
- NPH starts to work in 1-1.5 hrs, peaks in 4-12 hrs and lasts up to 24 hrs (usually no more than 18-20 hrs) but rarely provides sufficient effect to allow for once daily dosing (typically dosed 2-3 times per day).
- Lispro/ aspart/ glulisine start to work in 5-10 min, peak in 0.5-1.5 hrs, and have a functional duration of 3-5 hours; however, a residual effect can be seen out to 6-8 hours. That is why there can be a problem with "stacking" with frequent correction doses.

Endocrine

- Regular insulin (subcutaneous) has a 30-60 min onset, peaks in 2-4 hrs, and lasts 8-12 hrs. (Should not be used as a correction dose. Use a rapid acting analogue instead.)
- U-500 insulin use entails some special concerns. It is used in OB patients, patients with lipodystrophy, very insulin resistant obese patients, and some others. If a patient was on U-500 at home, it is suggested that an endocrinologist be involved. The diabetes teaching team should also work with the patient’s nurse.

Special situations --- TPN and Tube feeds

The key point is to use the insulin infusion rate to take a lot of the guesswork out of calculating the correct dose.

TPN

- Do not add insulin to the TPN bag until the patient is stable and the insulin requirement has been established using the insulin infusion protocol. Calculate the insulin requirement by adding up the number of units of insulin the patient received via the protocol for the previous 12 hours and multiply by 2 for the 24 hour requirement.
- Add 80% of the calculated 24 hour dose of insulin to the next night’s TPN bag. **Stop the insulin infusion when the insulin containing TPN bag is started.** (This is critical.) **Exception: see below for cyclic TPN .** Cover with the subcutaneous insulin algorithm for hyperglycemia Q6H. Choose the algorithm based on the total amount of insulin required (<40 units = low dose, 40-80 units = medium dose, > 80 units = high dose). Adjust the amount of insulin in the TPN daily until the patient has adequate glycemic control (BG 140-180).
- If the patient is on **cyclic TPN**, make sure to use the insulin infusion rate during the time the TPN is running to calculate the amount of insulin to be added to the TPN bag. The patient may still need the insulin infusion restarted when the TPN is not running.

Tube Feeding

Continuous tube feeds	<ul style="list-style-type: none">• Continue the insulin infusion protocol.• If changing to subcutaneous insulin, use the insulin infusion requirement to calculate the dose, as described above, then divide the calculated dose into q6 hour doses of regular insulin.
Bolus tube feeds	<ul style="list-style-type: none">• Give regular insulin 30-45 minutes before the bolus feed and check finger stick glucose two hours later.• Adjust the dose of insulin to achieve post bolus target glucose of 140-180 with the goal to be as close to 140 as possible.
Cyclic tube feeds	<ul style="list-style-type: none">• Eight hour cycle: Use 10-15 units of NPH and 6 units of regular at the start of the cycle.• Twelve hour cycle: Use 10-15 units of NPH and 6 units of regular, but re-dose the regular insulin six hours into the feed.• Titrate the insulin dose up by 2-4 units per day until you achieve adequate glycemic control (BG 100-150).• The patient should also be covered with the subcutaneous insulin algorithm for hyperglycemia q4 hours rather than pre-meal. Choose the algorithm based on the total amount of insulin required (i.e. <40 units = low dose, 40-80 units = medium dose, > 80 units = high dose).

Remember--“The lab is the gold standard, not the glucose meter.”

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