Perioperative glucose control: What an ophthalmologist needs to know
Dr. A.G. Unnikrishnan

Why control glucose in patients undergoing surgery?

Glucose control in the perioperative period is important for several reasons: firstly, hyperglycemia has been associated with perioperative mortality and morbidity. Secondly, hyperglycemia can lead to infections and impaired wound healing. Finally, there is sufficient clinical trial evidence to suggest that achieving normoglycemia can prevent minor and major complications in the postoperative period.

What are the targets for perioperative glucose control?

The targets for glucose control in the perioperative period are summarized in table 1. Targets must be institution-specific. In other words, before setting targets for a particular institution, the following issues must be taken into consideration: the patient’s affordability, availability of glucometers and nursing staff, and availability of doctors in the hospital. Intensive glucose control requires repeated glucometer-based testing, without which there is a risk of hyperglycemia. These targets hold good even if the patient is not a known diabetic, as glucose control has been shown to improve outcomes even in this particular subset. For minor surgeries, a short period of euglycemia before surgery is acceptable. However, for prolonged surgeries requiring general anesthesia, at least a fortnight of good control before surgery is essential, as this is required to reverse neutrophil dysfunction in diabetic subjects. A HbA1c value <7% also indicates good control.
Table 1. Targets for in-hospital perioperative glucose control

**Before and After Surgery (monitor glucose every 2-4 hours):**

- Fasting Plasma Glucose: 90-110 mg/dl
- Postprandial Plasma Glucose: 90-180 mg/dl
- In patients not eating, Random Plasma Glucose: 90-180 mg/dl

**During Surgery/ in the Surgical ICU (monitor glucose every 1-2 hours):**

- Random Plasma Glucose: 140-110 mg/dl

*Modified From: Guidelines of the American Association of Clinical Endocrinologists (AACE)*

**Achieving targets in cataract surgery/ similar procedures**

A simple flow chart is displayed in figure 1. In general, it is not advisable to make the diabetic patient fast for more than 4-6 hours. This is because fasting causes stress, and this releases hyperglycemia-inducing hormones like cortisol, catecholamine and growth hormone. In addition, fasting leads to catabolism, and causes the breakdown of adipose tissue to free fatty acids (FFAs). The FFAs, in turn, inhibit insulin secretion and interfere with insulin action- this triggers a vicious spiral of hyperglycemia.

**Figure 1. An algorithm for managing hyperglycemia on the day of cataract surgery.**

Note: After Surgery, i.e. that day itself, the patient should take the same dose of oral drugs/ insulin, which he/she had been taking earlier.
Achieving targets for major surgeries

In this case, the patient is likely to require prolonged general anesthesia, and it is also more likely that the patient is more ill. In these situations, an insulin infusion from the morning of surgery is useful (see figure 2). This can be delivered either by adding insulin in a pint of dextrose/ dextrose normal saline and infusing it. However, delivering it via an insulin infusion pump is a better strategy, and is outlined in figure 2. Combining insulin infusion with dextrose means that the patient will be obtaining calories and will not be starving: thus the stress response as well as catabolism associated with starvation can be prevented, and post-operative outcomes can be improved.

The ideal regimen and the inappropriate sliding scale

The sliding scale in a descriptive term for a fixed insulin protocol that is stuck on the notice board of some wards. The sliding scale essentially means that small doses of short acting insulin are given intermittently, depending on a table that says “x” units for a particular glucose level. The sliding scale is dangerous, as it does not take into account post meal excursions, and can result in a rollercoaster-like sugar fluctuations. It has been estimated that about half of in-hospital hypoglycemia is related to sliding scale use. It is desirable that the sliding scale is replaced by more physiological insulin regimens like the insulin infusion protocols or the basal-bolus regimen. The basal bolus regimen consists of giving long (or intermediate) acting insulin once daily (usually at bedtime) to set the base and a bolus dose of short acting three times a day before each meal. The fasting glucose is corrected by adjusting the long acting insulin, while the postprandial glucose is corrected by titrating the dose of short-acting insulin. Among the various insulin regimens, twice daily premixed insulin is the most practical, and can be used to achieve preoperative control

---

**Figure 2. Intravenous insulin infusion for major surgeries**

Step 1. Load insulin by adding 50 units short acting insulin in 50 ml of normal saline in a syringe pump.

Step 2. Give a bolus dose of insulin. To decide the bolus dose, divide the current blood glucose by 50. For e.g. if the glucometer reading is 350 mg/dl, 350/50 = 7 units is the bolus dose of insulin to be given IV.

Step 3. Set the hourly infusion rate on the infusion pump. To decide the rate, divide the current blood glucose by 100. For e.g. if the glucometer reading is 350 mg/dl, then the infusion rate is 350/100 = 3.5 units per hour. If the patient is fasting or will be fasting for more than 4-6 hours, also add 5% dextrose at 100 ml/hr with 10-20 mmol of potassium/500 ml.

Step 4. Readjust dose by Checking Glucose levels every 1-3 hours. Assume that the target range is 90-180 mg/dl. If the glucose level is below 90 mg/dl, decrease infusion rate by 1-3 units/ hour. If the glucose is > 180 mg/dl, increase the infusion rate by 1-3 units/hour.

Step 5. Prevent hypoglycemia: If the glucose falls below 80 mg/dl, stop the infusion and give 1 ampoule of 25% dextrose. Recheck sugars hourly and restart infusion if sugars rise to > 180 mg/dl.

Step 6. Stopping Infusion: If the insulin infusion is being stopped; give a dose of s/c insulin half an hour before stopping the infusion.

---

Note: This infusion is not based on any particular published protocol, and has been tailored to the Indian setting by the author. An internationally accepted protocol is the Yale insulin infusion protocol; visit: www.glycemiccontrol.net/pdf/Yale%20Insulin%20Infusion%20Protocol4.pdf for a free download.
(see figure showing various regimens). The ideal regimen should be individualized for each patient. The success of any regimen for perioperative glucose control requires teamwork between the surgeon, physician, anesthetist as well as paramedical personnel.

**Figure 3. Insulin patterns**

The top figure represents endogenous insulin secretion of by the pancreas, which all regimens must mimic. There is a "basal" insulin secretion throughout the day, on which is superimposed bolus secretions at the time of each meal. The twice daily (using 30: 70 premixed insulin) and the thrice daily treatment regimens (using one long acting insulin and three short acting insulin injections are both popular regimens for in-hospital control.

**References**


