Indian Journal of Anaesthesia and Analgesia
Volume 3 Number 2, May - August 2016

Perioperative Glycemic Control: An Overview

K.K. Mubarak

Professor & Head of Anaesthesiology, Govt. Medical College, Thrissur, Kerala.

Diabetic patients are more likely to undergo surgical procedures, which can disrupt their routine glycemic control. Perioperative dysglycaemia (hyperglycaemia, hypoglycaemia, stress-induced hyperglycaemia and glucose variability) is common in these patients. Perioperative glycaemic control include preoperative optimization of diabetes, identification of undiagnosed diabetes and other forms of dysglycaemia, intraoperative glucose control, and postoperative care with return to their regular diabetic management.

The American Diabetes Association (ADA) describes three categories of inpatient dysglycemia:

1. Previously diagnosed diabetes
2. Unrecognised diabetes with inpatient hyperglycemia persisting after discharge
3. Hospital related (Stress-induced) hyperglycemia (SIH) which returns back to normal, when the counterregulatory hormone surge is abated.

In addition, the prediabetes states of Impaired Fasting Glucose (IFG), Impaired Glucose Tolerance (IGT) and gestational diabetes mellitus (GDM) are continuum with overt diabetes and can manifest with hyperglycemia in the perioperative setting. They can have stress-induced hyperglycemia perioperatively, which can worsen their glycemic state.

Hyperglycemia is associated with adverse outcomes in surgical patients, irrespective of whether the patient is a known diabetic or not. A fasting blood glucose or HbA1c if fasting values are doubtful is an essential preoperative test, which also screen for diabetes in an otherwise healthy patient. Preoperative HbA1c above 7% has a high risk for postoperative wound infections. There is impaired neutrophil function if blood glucose level is above 200 mgm% with a strong association between perioperative hyperglycemia and nosocomial infections.

Although current anesthetic and surgical techniques have minimal impact on the metabolic stress producing hyperglycemia, the benefits of good glycemic control during the perioperative period offers a better surgical outcome. Anesthetic agents can affect glucose metabolism by modulation of the sympathetic tone. Inhalational anaesthetic drugs can suppress insulin secretion causing hyperglycemia, particularly in those with insulin resistance, raising the risk of ketoacidosis. The use of regional anesthesia or peripheral nerve blocks may mitigate these concerns, but no data suggest that it will improve the postoperative outcome.

Targets for Perioperative Glycemic Control

The optimal blood glucose target in the perioperative setting depends on the clinical conditions like type and duration of surgery, presence of infection, cardiopulmonary bypass and pregnancy. Elective surgeries should be postponed if the preoperative glycemic control is poor (HbA1c ≥8%). The aim is to achieve a near normal glucose metabolism, avoiding hypoglycemia and maintaining blood glucose levels at 90-180 mgm%. For this, surgical units should have facility for bedside glucose monitoring and to infuse glucose – insulin infusions as required.

Type I / Type II Diabetes

Type I diabetic patients are prone for ketosis if insulin is withheld, especially during stressful conditions like perioperative period, due to increased secretion of counter regulatory hormones. Type II diabetic patients can also develop ketosis, when there is a relative deficiency of insulin, especially in those who are on insulin therapy. To prevent hyperglycemia, they should be controlled with insulin preoperatively.

Minor / Major surgery

Regarding diabetic control, day care surgeries are

considered as minor surgery, as these involves little interruption of their routine dietary and drug regime. Surgeries which require overnight admissions and those with disruption of their routine diet and diabetic therapy are considered as major and managed accordingly.

Principles of Management

As the preoperative glycemic control significantly alters the surgical outcome, elective surgery should be done only when the diabetic status is under reasonable control, with neither hypo nor hyperglycemia, and $HbA_1C<8\%$. Diabetic gastroparesis should be sought for, as they have a high risk of pulmonary aspiration due to increased residual gastric contents and require longer period of preoperative fasting. Due to nausea and vomiting, they may not resume oral feeds which may complicate their postoperative glycemic control postoperatively. Preoperative fasting, interruptions to the routine dietary and drug regimen along with the stress of anaesthesia and surgery contribute to the poor perioperative glycemic control, leading to prolonged hospital stay with increased morbidity and mortality. These patients have to be taken up for surgery in the morning itself, preferably as the first case, to avoid prolonged fasting and hypoglycemia. Clear instructions regarding blood glucose monitoring and insulin adjustments should be given prior to surgery. Prolonged preopeoperative fasting increases catabolism and promotes insulin resistance. These patients require glucose-insulin infusion during the fasting period itself. Patient should be adequately hydrated prior to the induction of anaesthesia.

Diet Control

In those diabetic patients on diet control with HbA1c <6.5%, no specific therapy is needed. However, they require frequent blood glucose monitoring in the perioperative period. If blood glucose is above 180mg%, glucose insulin infusion is started and continued till they resume oral feeds.

Oral Hypoglycemic Agents

Oral antidiabetic drugs are stopped on the day of surgery and restarted once the patient resumes their normal feeds. Secretagogues (eg, sulfonylureas) can cause hypoglycemia and interfere with ischemic myocardial preconditioning increasing the risk of myocardial ischemia. These patients require short-acting insulin perioperatively depending on the type and duration of surgery. Glucose insulin infusion is administered if blood glucose >180 mg%, if surgery is prolonged or if they are on more than one oral antidiabetic agent. Metformin need not be stopped before minor surgery. But before major surgery it is discontinued due to the risk of lactic acidosis, especially in conditions of high lactate production like hypotension and myocardial ischemia. As prolonged stoppage may result in hyperglycemia, it is stopped on the day of major surgery and resumed 24 hours postoperatively, provided the serum creatinine level is acceptable. Glucose insulin infusion is given if withdrawal of metformin results in poor glycemic control.

Insulin

Diabetic patients on insulin require perioperative insulin therapy. Patients are advised to reduce their usual insulin dose the night before surgery to prevent hypoglycemia.

Maintenance insulin may be needed, based on the glucose levels and discretion of the clinician. Patients should be monitored to detect hyper / hypoglycemia.

Minor Surgery

The usual insulin and diet is maintained till the night before surgery. Patient is fasted overnight and the morning dose of insulin is delayed, if the procedure will be over by around 10 AM and the patient is able to take oral feeds with their routine insulin. If the procedure goes late, a reduced dose of insulin may be given. Glucose insulin infusion is started if the blood glucose is above 180mg %. If the diabetic status is under poor control, glucose insulin infusion has to be started in emergency situations even for minor surgeries.

Major Surgery

Patient is fasted overnight and the morning dose of insulin is skipped. Glucose insulin infusion is started prior to the induction of anaesthesia and continued postoperatively, till the patient is able to take oral feeds. Blood glucose is monitored hourly intraoperatively and postoperatively, till they are stable.

Subcutaneous Insulin Pumps

For minor surgeries, the usual basal infusion rate is continued, with hourly blood glucose monitoring. During major surgery, subcutaneous insulin

absorption may be erratic due to hemodynamic fluctuations and increased counter regulatory hormones. Hence they should be converted to glucose insulin infusion for proper glycemic control.

Glucose Insulin Infusion

This is the best way to maintain tight glycemic control in the perioperative period without producing hypoglycemia. It requires blood glucose monitoring, every 1-2 hours. If the initial blood glucose is high, glucose infusion is not started until the blood glucose level is controlled. Otherwise, insulin is not infused without glucose infusion, to avoid hypoglycemia.

Post-Operative Period

Glucose insulin infusion is continued till the patient is able to take oral feeds. When solid food is started, the usual subcutaneous insulin is given and the glucose insulin infusion stopped within 1-2 hours. Oral antidiabetic therapy is also started once the patient starts their oral feeds. Glucose levels may fluctuate during this period due to the metabolic stress of surgery, pain, infection and altered food intake and diabetic management. Removal of infective source or delivery of fetus may bring down the glucose level, causing hypoglycemia in the postoperative period. In such cases, insulin dosage is reduced and the whole regimen is reviewed. If oral intake is variable and cannot be relied, glucose insulin infusion is resumed till the oral intake is steady. Patients who are not detected to be diabetic, but required insulin perioperatively often requires continued insulin therapy, which has to be converted to subcutaneous injections postoperatively. If their HbA1c is >7%, it is likely that they had undetected diabetes preoperatively.

"Sliding Scale" Insulin

This was traditionally used to manage perioperative hyperglycaemia. It involves administration of insulin when the blood glucose is within specified ranges, with insulin being withheld when the blood glucose is within the normal range. It is retrospective and aimed at correcting rather than preventing hyperglycaemia. When used as sole therapy, it can lead to inappropriate insulin administration, resulting in large swings in blood glucose levels. "Correction insulin," is the use of additional short or rapid acting insulin in conjunction with the scheduled insulin doses to treat blood glucose levels above desired targets. Prolonged therapy with sliding scale is ineffective and potentially dangerous, especially in type 1 diabetes.

Intensive Insulin Therapy (IIT)

American College of Physicians (ACP) defines it as the use of intravenous insulin to achieve target blood glucose level with frequent blood glucose testing and adjustment of insulin dose. In intensive care unit (ICU) settings, the usual target is 80 to 110mg/dL, whereas in non-ICU settings it is <200 mg/dL. IIT is associated with risk of hypoglycemia, extended hospital stay and increased mortality. However, poorly controlled hyperglycemia is associated with increased morbidity and mortality due to poor immune response, increased cardiovascular events, thrombosis, inflammatory changes and delayed wound healing.

While evidence is not sufficient to give a precise range for blood glucose levels, target values of 140 to 200 mg/dL is a reasonable option, as this is associated with similar mortality as IIT targeted at blood glucose levels of 80 to 110 mg/dL with lower risk for hypoglycemic episodes. Although hypoglycemia is higher with lower target glucose values, it can also occur in patients on insulin with target blood glucose levels of 140 to 200 mg/dL.

Insulin Infusion

Separate intravenous access for a "piggyback" infusion of regular insulin (100 U per 100 mL 0.9% saline) is recommended. The infusion rate is determined as insulin (U/hr) =serum glucose (mg/dL)/150. Intra-arterial catheter is recommended for checking blood glucose concentrations 1-2 hours intraoperatively and postoperatively. A second intravenous catheter is used for intravascular volume replacement.

Conclusion

Management of patients with diabetes mellitus in the peri-operative period requires cooperation and communication between surgeons, physicians and anaesthesiologists. To keep blood glucose levels within the target range, medications need to be tailored during this period. There may be individual variations in the impact of surgery and adjustments made to the therapy, depending on the pre-existing diabetes status, nature and duration of surgery and perioperative complications.

Although optimal target glucose ranges remain controversial, the era of "tight" glycemic control has been changed to "less-tight" glycemic control, focusing on patient safety and efficacy oftherapy.

References

1. Glycaemic control in the perioperative period. Sebranek, J. J, Lugli, A. Kopp; Coursin, D. B, British Journal of Anaesthesia. 2013 December; 111 (Supplement): 8-34.
2. American Association of Clinical Endocrinologists And American Diabetes Association Consensus Statement On Inpatient Glycemic Control: Endocrine Practice May/June 2009.
3. Use of Intensive Insulin Therapy for the Management of Glycemic Control in Hospitalized Patients: A Clinical Practice Guideline From the American College of Physicians Ann Intern Med. 2011.
4. Management of Hyperglycemia in Hospitalized Patients in Non-Critical Care Setting: An Endocrine Society Clinical Practice Guideline J Clin Endocrinol Metab 2012.
5. An Overview of Preoperative Glucose Evaluation, Management, and Perioperative Impact. Ann M Sheehy, M.D., M.S.Robert A Gabbay, M.D., Ph.D, J Diabetes Sci Technol. 2009 Nov; 3(6): 1261–1269