PERI-OPERATIVE MANAGEMENT OF THE DIABETIC PATIENT

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Diabetes is the most prevalent endocrine disorders in the United States. Cardiomyopathy, nephropathy, and generalized end organ diseases are commonly seen within this population. The podiatrist plays an important role in the prevention, maintenance, and treatment of pedal deformities caused by peripheral neuropathy. Proper management of the diabetic surgical patient is extremely important for prevention of both hyperglycemic and hypoglycemic reactions. In the past, patients with diabetes suffered a high complication and mortality rate. The principal causes of postoperative morbidity, ketoacidosis, malnutrition, and infection, have been dramatically reduced by improved methods of patient management.

PREOPERATIVE EVALUATION AND MANAGEMENT

A thorough preoperative assessment of the diabetic patient is mandatory. This assessment involves the metabolic, cardiovascular, and immune systems. Although much of the work-up can be performed in a physician's office prior to elective surgery, hospital admission one day prior to the procedure is recommended for optimal control of Insulin-dependent diabetes mellitus.

Routine laboratory work-up should include blood chemistry, complete blood count with differential, glycosylated hemoglobin (HbA1c), urinalysis, and an electrocardiogram. Awareness of serum potassium is especially important in patients on long term diuretic therapy resulting in hypokalemia. Other forms of volume depletion including vomiting and diarrhea will also result in a loss of potassium. Hypokalemia may be a major factor contributing to cardiac arrhythmias during anesthetic induction. Hyperkalemia may accompany acidemia and usually corrects with treatment.

Glycosylated hemoglobin is a good indicator of patient compliance with their diabetic control by evaluating the average blood glucose over the past three to four months (life span of the RBC). Glucose will selectively bind to the beta chains of hemoglobin within the red blood cells, and results in an irreversible binding for the life of the RBC. Normal values range from 3.4 - 6.1 % total Hb. Conversion from these values to blood glucose is achieved by the formula

(HbA1c * 33.3) - 86 = Blood glucose

Evaluation of the CBC can indicate the potential for wound healing as described by Dickhaut, et al. Total lymphocyte count and albumin values should be at least 1,500 cells/mm3 and 3.5 gms/dcl respectively. The total lymphocyte count equals (white blood-cell count) * (percentage of lymphocytes).

Patients on oral hypoglycemics (sulfonylureas) undergoing major surgery should have these medications discontinued prior to surgery. Diabinese (Chlorpropamide) has the longest half-life (36 hours) of all the available agents, and should be stopped 2-3 days prior to surgery. It is best to manage these patients with insulin in the intra- and postoperative period. Orally administered drugs can be restarted when a normal diet is resumed.

PERI-OPERATIVE MANAGEMENT

Early morning surgery should be arranged for diabetics whenever possible. Surgery later in the day can be compensated for and managed well, but long periods of starvation are not ideal for the diabetic patient. Intermediate acting insulin chosen for glycemic control early in the morning may peak in the afternoon complicating adequate management.

Surgery by itself will elicit a diabetogenic response. The stresses produced by the underlying disease, the surgery, and anesthesia will result in the production of a number of counter-regulatory hormones. These suppress insulin secretion and stimulate gluconeogenesis, glycogenolysis, and tissue resistance to insulin. General anesthesia can alter carbohydrate metabolism significantly and produce a hyperglycemic effect. Properly administered local, spinal, and epidural anesthesia have little or no affect on glycemic control. Epinephrine can however stimulate muscle glycogenolysis, which provides lactate for hepatic gluconeogenesis.

Diabetics well maintained with diet-control and oral hypoglycemics might tolerate the stresses of surgery well and follow the "no glucose - no insulin" regimen. Blood sugars should be taken preoperatively, postoperatively and also intra-operatively during longer procedures. Although these patients are relatively well-controlled, these individuals have limited reserves of endogenous insulin and the stress of surgery may sometimes push them into hyperglycemic states. If preoperative blood sugars rise above 250 mg/dl, sliding scale subcutaneous or intravenous regular insulin coverage is indicated. A constant infusion of 0.5 - 1.0 U/hr in half normal saline and 5% dextrose solution is recommended. If sugars are still elevated postoperatively, the patient should be controlled with subcutaneous sliding scale coverage every 4-6 hours after routine accuchecks. This is especially important within the first 24 hours after surgery due to the increased serum concentration of insulin antagonist hormones present. The patient returns to their normal regimen when glycemic control is adequate.

The treatment of insulin-dependent patients is more involved. There are generally two thoughts on glycemic control during surgery in Type I diabetics. The basic tenet both regimens follow is that insulin coverage is required, yet the route of administration differs. The oldest method is known as the "split-normal dose" technique. One-half of the normal dose of intermediate duration insulin (NPH or lente) and regular insulin (if applicable) are given subcutaneously in the morning preoperatively. If morning blood sugars are >200 mg/dl, two-thirds of the normal dose should be administered. Breakfast is replaced by infusion of 5% dextrose and half-normal saline at 100-150 ml/hr and continued throughout the procedure. Fluctuations in the glucose levels are managed by altering the infusion rate or by adding insulin. The remainder of the normal insulin dose is given in the recovery room.

Taitelman, et al, in 1977 was the first to report the use of continuous low-dose insulin infusion technique. This involves continuous IV infusion of regular insulin coupled with a separate infusion of dextrose and water. Although the infusions are separate, they are piggybacked in the same vein. This is becoming more popular due to its flexibility and improved moment to moment control. The recommended infusion rates include 1 - 3 U/hr of regular insulin along with 100 mL of 5% dextrose and half-normal saline per hour. If daily insulin requirements are less then 40 units, start with 1.0 U/hr; 40 - 80 units, then 1.5 U/hr; if the insulin requirements are >80 units, start with 2.0 U/hr. Insulin infusion is best managed with an accurate infusion pump, such as IVAC or IMED. The goal of continuous infusion management is glucose levels of 150 - 250 mg/dl. To avoid iatrogenic hypoglycemia, intra-operative blood glucose levels should be determined every 1 - 2 hours. Serum glucose determination is far superior to urine glucose measurements due to renal threshold changes and nephropathy usually seen in diabetics.

Many authors have reported added insulin absorption in IV bottles and infusion tubing, effectively decreasing actual insulin infusion to the patient. This can be avoided by adding albumin or several mls. of the patients own blood to the solution, which serves to adhere to these surfaces in place of insulin.

Emergency surgery in a diabetic patient due to trauma or infection needs to be addressed. Due to the severe stress on the body, the patient

will often be under significant metabolic decompensation and progress into a state of ketoacidosis. Ketoacidosis is defined by a triad of hyperglycemia, ketosis, and acidosis. Often little time is available for stabilization of the patient, but even a few hours may be sufficient for correction of fluid and electrolytes disturbances. The likelihood of arrhythmias and hypotension resulting from ketoacidosis will be reduced if hypokalemia and volume depletion are at least partially treated.

Hypotonic IV and insulin infusion is started immediately. Insulin therapy is initiated with a 10-unit bolus of regular insulin followed by continuous insulin infusion. Because the number of insulin binding sites can become saturated, the maximum rate of serum glucose decline is fairly constant. This averages 75-100 mg/dl/hr regardless of insulin dose. As serum glucose drops to 250 mg/dl, the IV should be changed to 5% dextrose with 1/2 NS to prevent hypoglycemia. As glucose rises initially by every 100 mg/dl, serum sodium decreases by 1.6 meq/L due to osmotic mechanisms. The sodium being lost will draw fluid along with it, thereby necessitating volume expansion in this recovery period. An increase in total volume with hypotonic solution will tend to reabsorb back the sodium, and regulation of electrolyte balance is initiated.

POSTOPERATIVE MANAGEMENT

In the postoperative stage, careful monitoring of glucose levels is prudent. Sliding scale coverage is indicated with regular insulin using a recovery room accucheck and subsequent mealtime accuchecks. Foley catheters should be discontinued as soon as possible in efforts to return the patient to their normal urinary control. Laboratory work routinely includes blood chemistry, complete blood count, and electrocardiogram. Electrolytes need to be monitored and are adjusted for through intravenous fluids if necessary. Often potassium chloride is required (20 - 40 mEq/L) for supplementation. An EKG is helpful in looking for silent peri-operative myocardial changes. Once the patient is stable and able to tolerate their normal diet, return to the previous insulin regimen is recommended.

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