PERIOPERATIVE MANAGEMENT OF THE PATIENT WITH DIABETES MELLITUS

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It is a well accepted fact that surgery and anesthesia are stress-inducing events which elicit certain physiologic responses. Among these responses are the liberation of certain hormones, such as epinephrine, glucagon and cortisol. This is of particular interest in the patient with diabetes due to the antagonistic effect of these hormones towards insulin, specifically in relation to blood sugars. The stress of surgery and anesthesia, in the patient with diabetes, can be a hyperglycemia-inducing event. This is of significant interest when the physician considers the known complications of hyperglycemia in the peri-operative period. It is beyond the scope of this paper to review all of the effects of these hormones, however, Table 1 lists their general effects on metabolism.

In addition to the usual events associated with hyperglycemia, such as ketoacidosis, electrolyte imbalances, and volume depletion secondary to osmotic diuresis, there are more surgically pertinent factors associated with elevated blood glucose concentrations. These factors include impaired wound strength and wound healing with blood sugars above 200 mg%. Studies have also shown that leukocyte function, specifically chemotaxis, opsonization, and phagocytosis are impaired with elevations in blood glucose possibly leading to an increase in wound complications or infections.

Table 1

METABOLIC EFFECTS OF HORMONES

Anabolic Effects

	Glycogenesis	Lipogenesis	Protein Synthesis
Insulin	+	+	+
Epinephrine	-	0	0
Glucagon	-	0	0
Cortisol	+/-	+/-	-
Growth Hormone	0	0	+

Catabolic Effects

	Glycogenolysis	Gluconeogenesis	Lipolysis	Proteolysis
Insulin	-	-	-	-
Epinephrine	+	+	+	-
Glucagon	+	+	?*	+
Cortisol	-	+	+	++
Growth Hormone	-	-	+	++

+, Stimulatory effect; -, inhibitory effect; 0, no effect; +/-, stimulatory in presence of insulin, inhibitory in absence of insulin.

*Effects increased with nonphysiological levels.

+Effects important in absence of insulin.

The goal for optimal patient care and surgical result in the patient with diabetes should, therefore, include normalization of blood glucose. The approaches to maintaining a euglycemic state in the pre- intra- and postoperative period will be presented.

PREOPERATIVE PERIOD

The preoperative work up on the patient with diabetes should include EKG, hemoglobin A1C, appropriate chemistry studies, urinalysis and any other routine labs such as a CBC. These tests, in combination with a thorough history and physical may help predict patients who are likely to require special attention and variation from standard protocols.

Along with any other preoperative orders, such as prophylactic antibiotics and blood glucose determination upon arrival on the day of surgery, fluid orders should be written. Lactated ringers (LR) solution, which is commonly used for many patients, should be avoided in diabetics. Lactated ringers contains 3 gm/L of lactate, which is a direct precursor to the gluconeogenic cycle, thus indirectly raising the blood sugar.

Preoperatively, a plan should be identified for managing the blood glucose intra- and postoperatively. This is an important part of the preoperative planning since it will determine what modifications in the patient's home insulin or oral hypoglycemic agents are required. The plan should be based on the following set of goals: fasting blood sugar below 150 mg/dl; no symptoms of uncontrolled diabetes; patient in a general anabolic state.

To aid in the decision making process, surgery will be classified as major or minor based on the length of the case and the type of anesthesia the patient is to receive. In general, a minor case will be less than two hours, while a major is greater than two hours and more likely to be performed under general anesthesia. Since many podiatric procedures may fall under the minor surgery classification, we will first consider these cases for both the insulin requiring and non-insulin requiring diabetic patient.

MINOR SURGERY

The well-controlled patient who is to undergo minor surgery, needs only minimal changes. The non-insulin requiring patient should not take any oral hypoglycemic agent on the day of surgery. Upon presentation to the hospital, a blood glucose determination should be carried out. If the blood glucose is greater than 150 mg/dl, insulin therapy should be started with regular insulin via a subcutaneous route of administration. Dosage may be determined by the simple sliding scale formula of [BG-100]/40. Dosing may be repeated every four hours as needed for good control. If the blood sugar is greater than 250 mg/dl, the patient should be started on an insulin drip as described for the insulin requiring patient. An IV of five percent dextrose in half normal saline should be started after the blood glucose determination and run at a rate of 120 cc/hr. This rate will supply the patient with approximately six grams of glucose per hour, enough to maintain a general anabolic status.

The insulin requiring patient, who is to undergo minor surgery, should take one half of their total daily dose of insulin in the intermediate form (NPH or Lente) on the morning of surgery. Upon arrival, these patients will also have a blood sugar determination, and an IV started with the same protocols as the non-insulin requiring patient. These patients, if stable, may then undergo the procedures of the day with subcutaneous sliding scale regular insulin coverage. If they are not stable, with a significant elevation of the blood sugar (>250) or a history of wide blood glucose variations and difficulty in control, the patient should be started on an insulin drip with a target range of 120-180 achieved prior to surgery and maintained throughout the perioperative period. (Table 2)

MAJOR SURGERY

In the non-insulin requiring patient, who presents on the day of surgery with a blood glucose under 150 mg/dl, the protocol is the same as for minor surgery. However, if the blood sugar is over 150, the patient is started on an IV insulin infusion (Insulin drip, see Table 2). Postoperatively, the patient is placed on sliding scale coverage with AC and HS monitoring, and if stable with minimal insulin requirements, oral agents may be resumed in one to two days.

Insulin requiring patients should take one half of their daily insulin requirement in the intermediate form on the morning of surgery and then an insulin drip should be started preoperatively with a target range of 120-180.

At this point, a comment on the use of IV bolus insulin administration (Direct IV insulin administration without the use of a drip) should

Table 2

Protocol for Insulin Drips in the Perioperative Period

1) Blood Sugar (BS) determination on arrival
2) Start Drip of regular insulin diluted 125 units in 500 cc of normal saline. (No filter on insulin drip line.)
3) Start IV of 5% dextrose in half-normal saline. Run at 120 cc/hr
4).Run Insulin drip at a rate of X units/hr
   where X= (BS- 60)x0.03
   (cc/hr = # units times 4)
5) BS determination Q 30 minute till stable in target range of 120-180 mg/dl.
6) Guidelines for IV rate changes:
   BS > 200, twice in a row and rising, increase multiplier by 0.01
   BS 120-200, no change in multiplier
   BS < 120, one time, decrease multiplier by 0.01
7) Call Doctor for BG < 70, or BG > 300 2 times in a row or if multiplier reaches 0.1
8) Hypoglycemic protocol
   If BS <80 and patient is taking PO fluids 1/2 glass orange juice and 1/2 glass milk and hold drip. If NPO or non responsive give 1/2 amp of D50. Recheck BS in 20 minutes and call physician.
9) Post op may decrease BS determinations to Q 2 hours when stable in target range for 3 hours and temp. and BP stable.

be made. Although this is not an uncommon practice, Hirsch et al. stated in 1991 that "This practice should be considered both unphysiologic and potentially dangerous." Since the half life of IV insulin is only 4-5 minutes and the biological half life is less than 20 minutes, this practice may cause severe swings in blood sugar with hypoglycemia occurring after the bolus and hyperglycemia following in 60-120 minutes.

INTRA- OPERATIVE MANAGEMENT

Intra-operatively, the patient's blood sugars should be monitored on an hourly or twice-hourly basis depending on the type of anesthesia and length of the procedure. For minor procedures, hourly monitoring should be sufficient, while major procedures with the patient under general anesthesia require twice hourly blood sugar evaluation.

The importance of monitoring of blood sugars cannot be overstressed, since the patient who is either under sedation or general anesthetic is incapable of relating any symptoms that may reflect out-of-control blood sugars. Therefore, if a patient is not monitored adequately, the first signs of uncontrolled blood sugars might be seizures (if the patient is not paralyzed) or arrhythmias on EKG tracing due to electrolyte abnormalities associated with uncontrolled blood sugars. To stress this point, it should be recalled that hypoglycemia may lead to irreversible brain damage.

POSTOPERATIVE MANAGEMENT

All patients with diabetes should have blood glucose and serum potassium levels determined upon arrival to the post anesthesia care unit and appropriate corrective measures taken for any abnormalities. Patients, who had minimal changes in their regimen, such as the patient on OHA or the insulin requiring patient who had only subcutaneous insulin for short procedures, may resume their regular regimen when stable and tolerating PO intake well.

Outpatients, who have been started on an insulin drip should be stabilized and the drip discontinued after PO intake is tolerated. The blood sugar should then be monitored closely and the patient's regular insulin or OHA regimen resumed with the next full meal.

House management for the patient on an insulin drip differs in so far as where possible the drip is continued through the first meal. If the patient is stable after the first meal with no complications, such as postoperative nausea and vomiting, the drip may be discontinued prior to the next meal and the patient's regular regimen resumed.

For patients who have undergone surgery, on a sliding scale subcutaneous administration of regular insulin, the scale may be continued for 24 to 48 hours. When stable, these patients may resume their routine, taking into account any changes in activity due to their operative procedures.

As a prophylactic measure, the recommendation has been made that all patients with diabetes should be started on metoclopramide (Reglan) postoperatively. This recommendation is based on several premises: 1) Many patients with diabetes are afflicted with gastroparesis to one extent or

another and this may be aggravated by anesthetic agents, 2) Metoclopramide, being an antiemetic agent, may help prevent postoperative nausea and vomiting and the electrolyte abnormalities associated with it or aspiration of gastric contents. Dosage should be 10 mg AC and HS for the patient with a serum creatinine of less than 2.0, and 5 mg for patients with a creatinine above 2.0.

EMERGENCY SURGERY

Emergency surgery for the patient with diabetes is a fairly common occurrence. The most common minor procedure for diabetic patients was found, by Galloway and Shuman, to be incision and drainage for infections of the lower extremity. Many times, these patients are found, upon admission to be hyperglycemic and often in a metabolic state of ketoacidosis due to the hormonal response to infection or trauma and the associated insulin resistance. The hyperglycemia and metabolic abnormalities should be stabilized prior to surgery. This will better allow the patient to withstand the stress of anesthesia and surgery. Stabilization can usually be achieved within 6 to 8 hours and surgical intervention can then be carried out.

SUMMARY

To optimize the surgical result and decrease patient morbidity associated with surgery and anesthesia in the diabetic patient, the surgeon should have a solid understanding of different methods available for management of blood sugars and know when each is appropriate. Further, the surgeon should not hesitate to cancel or postpone a case until sugars are under optimal control as this may ultimately improve the result.

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