Preparing People with Type 2 Diabetes for Elective Surgery

By

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A clinical project paper submitted in partial fulfillment of the requirements for the degree of:

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The members of the committee appointed to examine the clinical project of MARIA IDELSI ORTMAN find it satisfactory and recommend that it be accepted.

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PREPARING PEOPLE WITH TYPE 2 DIABETES FOR ELECTIVE SURGERY

Abstract

By

Maria Idelsi Ortman, RN, BSN

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Summer 2008

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The nurse practitioner’s role in preparing a person with type 2 diabetes for surgery involves good communication and education about various aspects of the process. Education in preparation for surgery should include how diabetes affects wound healing and how surgery may alter blood sugar levels. Patients should receive information concerning the preoperative period, the surgical experience and the recovery period. Good communication involves not only the patient but also the surgeon with whom it is important to discuss the patient and any pertinent information. Nurse practitioners who are leaders in providing good quality care can use their skills to achieve better patient outcomes for people with diabetes undergoing surgery who are prone to problems such as delayed wound healing and increased infection rates.
INTRODUCTION

The nurse practitioner (NP) cares for dynamic, complex patients with chronic illnesses. This includes patients with diabetes mellitus (DM), a condition affecting approximately 7% of the population (American Diabetes Association [ADA], 2005). Patients with DM have increased risk for mortality related to end organ damage and chronic complications such as retinopathy, neuropathy and atherosclerosis. DM is also a predictor of postoperative myocardial ischemia and postoperative infectious complications (Rothenberg & Loh-Trivedi, 2006). It is important that NPs understand that people with diabetes are a vulnerable population as many do not understand the significance of their illness and do not engage in self-management. The NP must provide patients with diabetes with guidance, education and a healthcare plan to decrease adverse outcomes. This is especially true when they are scheduled for elective surgery such as carpal tunnel, cataract, hip and knee replacement or other non-urgent procedures.

Preoperative screening is an attempt to reduce problems, optimize patients’ health and minimize delays or cancellations while making patient safety a priority (National Guideline Clearinghouse [NGC], 2006). Typically the surgeon decides if this screening will be completed by the primary care provider, the surgeon, or in an anesthesia preoperative evaluation. If the procedure is to be performed at an outpatient clinic or surgery center there may be an anesthesia provider on staff that performs the evaluation. As more surgeries are performed on elderly individuals with higher levels of co-morbidities, it is important for providers to be knowledgeable about optimal preoperative preparation (Adesanya & Joshi, 2006). This article focuses on preparing people with type 2 diabetes for an elective non-cardiac, non-high risk procedure to decrease risk of postoperative infection and other adverse events.
THE EFFECTS OF SURGERY ON BLOOD GLUCOSE

Surgery induces a stress response by the neuroendocrine system through the release of catecholamines, glucagon, and cortisol. During this stress response, a person without diabetes is able to maintain glucose balance by secreting insulin. In the patient with diabetes, this compensatory mechanism is impaired and the patient may require supplemental insulin. Inhaled anesthetic agents affect glucose metabolism by suppressing insulin secretion while regional anesthesia or peripheral nerve blocks do not cause the same problems (Rothenberg & Loh-Trivedi, 2006). The release of counter-regulatory hormones by the neuroendocrine system results in peripheral insulin resistance, increased hepatic glucose production, impaired insulin secretion, fat and protein breakdown and a potential for hyperglycemia. Hyperglycemia impairs wound healing because it diminishes the strength of collagen formation and it inhibits the body’s defenses against fighting infection including many leukocyte functions (Marks, 2003). The degree of the response varies per individual and is related to lack of caloric intake, volume depletion, the complexity of the surgery and any postoperative complications (Khan & Ghali, 2007).

POTENTIAL POSTOPERATIVE COMPLICATIONS

People with diabetes are at risk for a variety of postoperative complications, especially if they have co-existing health problems. Potential complications in patients with atherosclerotic vascular disease are myocardial infarction and stroke. Patients with peripheral vascular neuropathy may experience complications, such as lower extremity ulceration, increased infection rates and inhibited wound healing. Patients with autonomic neuropathy may have decreased bladder tone or gastroparesis while those with nephropathy may have renal insufficiency. The presence of retinopathy may lead to limited visual acuity for ambulation and
greater risk for disorientation/delirium (Rothenberg & Loh-Trivedi, 2006). Of all these potential complications inhibited would healing and increased infection rates correlate with hemoglobin A1c levels equal to or greater than 7% (Dronage et al., 2006).

**THE AFFECT OF GOOD GLYCEMIC CONTROL ON POST OPERATIVE COMPLICATIONS**

The risk of postoperative infections, including pneumonia, wound infections, urinary tract infections and sepsis, can lead to poor outcomes and is higher in patients with diabetes. There are many studies on how postoperative glycemic control in cardiac or major vascular surgeries affects infections rates. Few studies have explored how the long-term control of blood glucose preoperatively, as measured by the percentage of hemoglobin A1c (HgA1c), affects postoperative infection in non-cardiac surgery.

Bishop and colleagues (1992) studied the influence of HgA1c levels in patient receiving penile prostheses and documented higher infection rates in patients whose HgA1c levels were greater that 11.5%. Wilson and colleagues (1998) refuted the findings but did not mention the number of subjects in the poor control group. Both these studies are old and used data that placed patients with HgA1c between 7-11% in a well controlled group which is not consistent with present recommendations. There are no comparable studies conducted within the last decade. Present recommendations from the American Diabetes Association are to reduce microvascular and neuropathic complications of diabetes. The goal for the individual patient is a HgA1c level as close to normal as possible (less than 6%) without significant hypoglycemia and the goal for patients in general is HgA1c levels of less than 7% (American Diabetes Association [ADA], 2007).
Dronage et al. (2006) conducted a study of 490 diabetic patients who underwent non-cardiac surgery at the Veterans Affairs Connecticut Healthcare (VACT) system. This study consisted of analyzing data from the National Surgical Quality Improvement Program (NSQIP) database at VACT. Descriptive analyses were done to quantify the relationship of each individual variable (age, race, diabetic treatment, ASA score, ADL assessment, case status, wound class, operation length and HgA1c levels) with infections. The study confirmed an association between preoperative HgA1c levels less than 7% and a decreased risk of postoperative infections across a variety of surgical cases including urologic, gastrointestinal/hepatobiliary, vascular and orthopedic.

**DEVELOPING A PLAN FOR PREOPERATIVE CARE**

Coordinating between the NP and surgeon is important to establish responsibilities during the preoperative period for patient education and if any special tests or recommendations should be included in the preoperative assessment. The surgeon is responsible for educating the patient about the surgery, assuming care of the patient during surgery and providing postoperative instructions and evaluation. The NP remains the patient’s primary care provider during and after the perioperative period. NPs are in a position to provide patients with education about their disease process and how improved glucose control provides better outcomes. The American Diabetes Association (ADA) has established a “to do list” for helping patients in planning their surgery that can also be used by health professionals for planning a safe surgery and recovery (Figure 1). The ADA recommends the best possible glycemic control several weeks before surgery to decrease the chance of hypoglycemia or hyperglycemia during surgery, decrease the possibility of infection and to promote healing (American Diabetes Association [ADA], 2001).
The ADA does not clarify how many weeks before surgery good glycemic control must be obtained; however, 4-8 weeks would be beneficial in reducing possible complications.

Since diabetes is a complex metabolic process, a comprehensive history and physical must be completed on all diabetic patients whether the surgery is a major or minor surgery. If the NP is the primary care provider, most of the patient history can be reviewed and provided on the preoperative assessment note. However, if the NP completing the preoperative assessment is unfamiliar with the patient then a comprehensive history and physical exam is recommended or conducted. The H&P includes details of current diabetes management such as duration of treatment, frequency of glucose testing, medication regimen, self-care measures and issues with complications. Figure 2 lists the components of the health history to assess for cardiac, neurological, peripheral vascular, renal or retinal disease (Rothenberg & Loh-Trivedi, 2006).

The preoperative physical assessment of a patient’s risk status before surgery emphasizes the cardiovascular system. There are several tools available to assess an individual’s cardiac risk. These include the Goldman Cardiac Risk Index or the American College of Cardiology (ACC)/American Heart Association (AHA) Preoperative Cardiac Risk Assessment instrument. They incorporate clinical predictors and functional status to predict cardiac risk (Unger, 2007). The ACC/AHA guidelines are the most current, updated in 2007. A resting EKG is obtained and if indicated an echo or treadmill stress test may need to be ordered. Figure 3 is an algorithm for a stepwise approach to perioperative cardiac assessment (Fleisher et al., 2008). The patient may need referral to a cardiologist if there is evidence of ischemia or if the patient presents with a history suggestive of ischemia.

People with autonomic neuropathy may develop an exacerbation of pre-existing symptoms after surgery so it is important to determine if symptoms are present before surgery.
These symptoms include tachycardia, orthostatic hypotension, constipation, diarrhea, delayed gastric emptying, and bladder dysfunction (Unger, 2007).

The physical examination includes a complete head to toe assessment including assessment of orthostatic hypotension, and a fundoscopic examination. Renal function is evaluated and patients with microalbuminuria are referred for a 24-hour urine collection test to determine creatinine clearance and glomerular filtration rate. Laboratory evaluation includes HgA1c, fasting lipid panel, liver function tests, urinalysis for ketones, protein, sediment and microalbuminuria, serum creatinine and electrolytes (Rothenberg & Loh-Trivedi, 2006 and Marks, 2003). Any patient in a high risk category may need to have an elective surgery delayed until medical conditions stabilize (Unger, 2007).

**BLOOD SUGAR AND MEDICATION MANAGEMENT PREOPERATIVELY**

If no major abnormalities other than an elevated HgA1c are present, the practitioner and the patient can discuss lifestyles modifications or additional medications that can be added to the patient routine to lower glucose levels prior to surgery. Maintaining target glucose range is highly individualized to each patient depending on complications of DM, average blood glucose levels, frequency of hypoglycemia or hyperglycemia, pharmacologic and non-pharmacologic therapy, and ought to reflect practical and safe glucose management (Khan & Ghali, 2007).

Monitoring blood sugar levels and initiation of new therapies should start as part of the plan of the preoperative physical assessment. Therapy may include: additional exercise or nutrition guidance, adding an additional oral agent, adding non-insulin injectables such as an incretin mimetic Exenatide (Byetta) or the initiation of insulin therapy (Joslin Diabetes Center, 2007). Patients must monitor their blood glucose levels before and after meals and at bedtime. The Joslin Diabetes Center established target blood glucose goals (Table 1). This may be lower for
newer type 2 diabetes patients who are more sensitive to lifestyle changes and medications or higher for patients with multiple chronic problems. Frequent monitoring of blood glucose levels is the key to developing a safe and effective therapy regimen. The goal is to reach target HgA1c levels of less than 7%, avoid unexpected hypoglycemia episodes and make the treatment regimen realistic and sustainable. Every drop in HgA1c levels reduces the risk of diabetes-related complications by over 40% (Joslin Diabetes Center, 2007).

General medication management for blood glucose prior to surgery includes holding sulfonylurea or other insulin secretagogues type medication which may possibly result in marked hypoglycemia the day of procedure. Agents such as α-glucosidase inhibitors (Precose), GLP-1 agonists (Exenatide), and DPP-4 inhibitors (Januvia) should also be held the day of procedure because they are mainly effective when the patient is eating. Thiazolidinediones can be continued if pills are allowed as they have rare hypoglycemic effects, however missing doses should not affect glycemic control due to their long duration of action. These can be resumed after the patient starts tolerating a normal diet. Metformin may cause a decrease in renal function and ought to be held on the day of the procedure while the sustained release formula is held the evening before the surgery. Metformin can be started 48 hours postoperatively after normal renal function has been guaranteed (Inzucchi, 2007).

On the morning of surgery the general rule is, if the patient is on an insulin regimen and fasting after midnight, the patient should administer one-half of the usual dose of intermediate acting insulin (NPH) or a full dose of long acting insulin (Glargine) and hold rapid or short acting insulin. If the patient is on glargine insulin at bedtime consider a reduction of 20% of the dose to prevent hypoglycemia (Inzucchi, 2007). If the patient is on premixed insulin (70/30, 75/25, 50/50) and fasting less than half of the usual morning dose is recommended to avoid
hypoglycemia (Joslin Diabetes Center, 2007). However, the patient ought to monitor blood glucose prior to insulin administration and hold insulin administration if blood glucose is less than 150. If the blood glucose is higher than 200mg/dl then regular insulin can be given in small doses (1-4 units) to achieve blood glucose levels between 100-150mg/dl (Inzucchi, 2007). Avoiding blood glucose levels below 100mg per dl or above 200mg per dl minimizes risk of hypoglycemia or hyperglycemia (Marks, 2003). If the patient is hypoglycemic overnight instruct patient to treat with glucose gel (Joslin Diabetes Center, 2007). Nevertheless, timing of the procedure is important. It is possible if the procedure is early and only breakfast will be delayed the patient can take their usual morning dose after surgery and before eating. (Khan & Ghali, 2007).

SURGERY AND POSTOPERATIVE CARE

It is recommended patients have their surgeries scheduled as early as possible to minimize the disruption of their management routine since they will have “nothing by mouth” orders. The NP must be familiar with routine regimens to explain what may happen the day of surgery and in the postoperative period. On the day of surgery the blood sugar is checked at home and the results conveyed to the staff when admitted for the surgery if the result was below 70 or greater than 250 or if they have any symptoms of low or high blood sugar. The surgeon and anesthesiology team can use this information to decide on management. Usually patients managed by diet alone do not require therapy however they may be given subcutaneous insulin if glucose levels rise over the desired target range (Khan & Ghali, 2007). Intraoperative therapy will depend on whether the surgery is minor or major. Usually a minor surgery will require no specific therapy. A major surgery, defined as a one that requires general anesthesia for more than one hour, may require that the patient be placed on an insulin infusion to manage glucose levels
Preparing People with Type 2 Diabetes

(Unger, 2007). The type of surgical procedure, the patient’s usual diabetic regimen and the quality of glycemic control are other factors to consider. Patients may receive intravenous D5W if they are hypoglycemic (Unger, 2007) or small doses of short acting insulin subcutaneously or intravenously if they are hyperglycemic (Marks, 2003).

Postoperatively, medication regimens can be restarted once the patient starts tolerating a regular diet. Establishing a blood sugar management regimen postoperatively depends on the patient’s diet or the nutritional intake, medications, or any complication such as nausea and vomiting (Hoogwerf, 2006). Metformin can be restarted after 48 hours and renal function has been established. Patients with renal insufficiency, significant hepatic impairment, or congestive heart failure should not be restarted on Metformin. Thiazolidinediones should not be restarted on patients that develop heart failure or problematic fluid retention (Khan & Ghali, 2007). Patients discharged home on the same day of surgery need to monitor blood sugar levels every 4 hours with clear instructions for notifying their provider if glucose levels steadily exceed the 250mg/dl level (Marks, 2003).

A patient on insulin therapy ought to monitor the blood glucose level approximately every 2 hours for several hours using insulin algorithms for supplemental insulin administration if needed. Generally, insulin management is estimated from previous insulin doses with half the preoperative insulin dose given as a basal dose. As the patient’s nutritional intake increases, insulin can be adjusted up towards the routine insulin regimen (Marks, 2003).

SUMMARY

NPs provide high quality care related to patient education and communication; the preoperative screening of patients with diabetes for surgery is one aspect of patient education that can be expanded upon to provide better patient outcomes, such as good wound healing and
decreased infection rates. While opinions may differ on the best approach to perioperative management of diabetes, the key to success is frequent blood glucose and maintaining optimal target blood glucose range. Providing education on the effect of surgery on blood glucose, possible post operative complications, and the affects of good glycemic control on postoperative complications may improve patient motivation to follow a plan of care. Patients actively engaged in self-care will be able to manage glucose levels to decrease the probability of having postoperative complications, be better prepared for changes to treatment plans and more willing to accept short term changes or possible long term changes in their treatment plan. This empowers the patient on self management and helps to decrease fears or misconceptions about surgery or their disease process.
PATIENT INFORMATION

Diabetes and Surgery

The prospect of surgery can make anyone feel worried and fearful. However, careful planning, especially for people with diabetes, can help you make your operation as safe as possible and your recovery period less stressful. The key is to start planning well before your surgery date. This “to do” list can help you cover all the bases before your operation.

1. Meet with your primary care provider or endocrinologist.

Work with your provider to develop a plan for getting your blood sugar in the best possible control several weeks before you have surgery. Having good control of your blood sugar will lessen the chance of high blood sugar (hyperglycemia) or low blood sugar (hypoglycemia) reactions during your operation. Good blood sugar control also makes infections less likely and promotes healing. Your provider may also want to do a complete medical history and physical examination and other tests before your surgery.

2. Talk to your anesthesiologist or nurse anesthetist.

This is the health professional who is responsible for monitoring your diabetes while your surgeon is performing the operation. Explain your medical history, including details about your diabetes. Be sure to include your current medication regimen and any diabetes-related complications you have. You may also want to discuss different types of anesthesia. Some procedures can be done with local or spinal anesthesia, allowing you to remain awake during the procedure. In such cases, recovery time is often shorter. Other procedures require general anesthesia, which puts you to sleep during your operation. More careful monitoring of your diabetes is required during the procedure and after you undergo general anesthesia.
3. Schedule your surgery for the early morning.

Try to get the first morning time slot in the operating room. There will be less of a chance for high or low blood sugar reactions while you are waiting for your operation and are unable to eat.

4. Talk to your provider in advance about how you will manage your diabetes immediately after your operation.

After surgery, you may need to adjust your medication or insulin doses based on your blood sugar level. Ask your provider how you should manage your diabetes so that you can prepare in advance.

5. Get a temporary disabled parking permit, if necessary.

If you are having orthopedic surgery or another operation that will make it hard for you to walk during recovery, go to your local Department of Motor Vehicles and request the appropriate paperwork. Ask your provider to sign it in advance so that you can get your temporary permit before your operation.

6. Fill any new prescriptions before your surgery.

Ask your provider and surgeon whether you will need any pain medication or other prescriptions after your operation. These may include antinausea pills, laxatives, or other drugs. Ask for the prescriptions in advance, so you can have the medications ready when you need them.

7. Find out how long you will need to recover.

If you will not be eating for an extended period of time, you and your provider will need to change your diabetes care regimen. Also, you may need to make arrangements with your workplace for an extended recovery time (ADA, 2001).
Figure 2

The health history should include the following:

- eating patterns, nutritional status, exercise history, and weight history
- current diabetes regimen including diet, medication, glucose monitoring results
- frequency, severity and etiology of acute complications such as hypoglycemia and ketoacidosis
- suggestive symptoms such as polyuria, polydipsia or blurred vision
- prior or current infections- skin, foot, dental or genitourinary
- symptoms and treatment of chronic complications
- non-diabetic medications that may affect blood glucose levels i.e. corticosteroids or other medications the patient may take for chronic illness such as hypertension and Hyperlipidemia
- risk factors for atherosclerosis- smoking, hypertension, obesity, dyslipidemia, and family history
- history and treatment of other endocrine disorders, or eating disorders
- family history of DM or endocrine disorders
- Lifestyle- tobacco, alcohol or substance use, cultural, psychosocial and economic factors that might affect DM management (Rothenberg & Loh-Trivedi, 2006).
Preparing People with Type 2 Diabetes

**Figure 3:**

ACC/AHA 2007 Perioperative Guidelines

**Figure 1.** Cardiac evaluation and care algorithm for noncardiac surgery based on active clinical conditions, known cardiovascular disease, or cardiac risk factors for patients 50 years of age or greater. *See Table 2 for active clinical conditions. †See Table 3 for estimated MET level equivalent. §Clinical risk factors include ischemic heart disease, compensated or prior HF, diabetes mellitus, renal insufficiency, and cerebrovascular disease. ¶Consider perioperative beta blockade (see Table 11) for populations in which this has been shown to reduce cardiac morbidity/mortality. ACC/AHA indicates American College of Cardiology/American Heart Association; HR, heart rate; LOE, level of evidence; and MET, metabolic equivalent.

(Fleisher et al, 2008)
Table 1

Goals of Glycemic Control for People with Diabetes

<table>
<thead>
<tr>
<th>Biochemical Index</th>
<th>Normal</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Fasting Plasma Glucose or Preprandial Glucose (mg/dl)</td>
<td>&lt;100</td>
<td>90-130</td>
</tr>
<tr>
<td>Average Postprandial 2 hour (mg/dl)</td>
<td>&lt;140</td>
<td>&lt;160</td>
</tr>
<tr>
<td>Average Bedtime Glucose (mg/dl)</td>
<td>&lt;120</td>
<td>&lt;110-150</td>
</tr>
<tr>
<td>HgA1C (%)- sustained</td>
<td>&lt;6%</td>
<td>&lt;7%</td>
</tr>
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</table>

(Joslin Diabetes Center, 2007)
References


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Joslin Diabetes Center (2007, April 30). Pre, peri and postoperative care. Joslin Diabetes Center and Joslin Clinic Guidelines for inpatient management of surgical and ICU.


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Committee Members

❖ Louise Kaplan: Chair
❖ Renee Hoeksel
❖ Melody Rasmor

Why is preparing people with diabetes for surgery important?

People with diabetes are at risk for a variety of postoperative complications such as:
• myocardial infarction
• stroke
• increased infection rates
• inhibited wound healing
Why is preparing people with diabetes for surgery important?

Screening patients for surgery is an attempt to:
- reduce problems
- optimize patient health
- minimize delays or cancellations

The effects of surgery on blood glucose

- Peripheral insulin resistance
- Increased hepatic glucose production
- Impaired insulin secretion, fat and protein breakdown
- Potential for hyperglycemia

Hyperglycemia

- Impairs wound healing because it diminishes the strength of collagen formation
- Inhibits the body’s defenses against fighting infection, including many leukocyte functions
Potential postoperative complications

- Myocardial infarction and stroke
- Increased infections rates and inhibited wound healing
- Decreased bladder tone or gastroparesis
- Renal insufficiency
- Limited visual acuity for ambulation and greater risk for disorientation

The affect of good glycemic control on postoperative complications

The American Diabetes Association (ADA) recommends the HgA1c level as close to normal levels for reduction of microvascular and neuropathic complications

Research

Study conducted by Dromage et al. in 2006 confirmed an association between preoperative HgA1c levels of ≤7% and decreased risk of infection
Developing a plan for preoperative care
- Coordination between the NP and the surgeon
- Comprehensive History and Physical Exam
  - Cardiac system
  - Autonomic neuropathy
- Blood sugar management
- Medication management
- Discuss surgery and postoperative care

Patient Information-Diabetes and surgery
- Meet with your primary care provider or endocrinologist
- Talk to anesthesiologist or nurse anesthetist
- Schedule surgery for the early morning
- Talk to provider about how you will manage your diabetes immediately after surgery
- Fill any new prescriptions before surgery
- Find out how long you will need to recover

Health History
- The health history should include the following:
  - Eating patterns, nutritional status, exercise history, and weight history
  - Current diabetes regimen including diet, medication, glucose monitoring results
  - Frequency, severity, and etiology of acute complications such as hypoglycemia and ketoacidosis
  - Suggestive symptoms such as polyuria, polydipsia or blurred vision
  - Prior or current infections - skin, foot, dental or genital urinary
  - Symptoms and treatment of chronic complications
  - Non-diabetic medications that may affect blood glucose levels (i.e. corticosteroids or anticoagulants) the patient may take for chronic illness such as hypertension and hyperlipidemia
  - Risk factors for atherosclerosis - smoking, hypertension, obesity, dyslipidemia, and family history
  - History and treatment of other endocrine diseases, or eating disorders
  - Family history of DM or endocrine disorders
  - Lifestyle - tobacco, alcohol or substance use, cultural, psychosocial and economic factors that might affect DM management
     (Rothenberg & Loh-Trivedi, 2006)
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<tr>
<td>Average Bedtime Glucose (mg/dl)</td>
<td>&lt;120</td>
<td>&lt;110-150</td>
</tr>
<tr>
<td>HgA1C (%)-sustained</td>
<td>&lt;6%</td>
<td>&lt;7%</td>
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</table>
### Blood sugar management
**preoperatively**

Morning of surgery:
- Check blood glucose
- Take oral medications as directed
- Use insulin as directed

### Medication management - Oral medications

<table>
<thead>
<tr>
<th>Oral Medications</th>
<th>Hold</th>
<th>Give</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfonylureas</td>
<td>Potential for marked hypoglycemia</td>
<td></td>
</tr>
<tr>
<td>Insulin secretagogues</td>
<td>Potential for marked hypoglycemia</td>
<td></td>
</tr>
<tr>
<td>Alpha-glucosidase inhibitors</td>
<td>Mainly effective when pt is eating</td>
<td></td>
</tr>
<tr>
<td>Incretin Mimetic (ILP-1 agonists)</td>
<td>Mainly effective when pt is eating</td>
<td></td>
</tr>
<tr>
<td>TZDs</td>
<td>If held missing dose should not affect glycemic control of long duration of action</td>
<td>Can be given if pills are allowed if rare hypoglycemic effects</td>
</tr>
<tr>
<td>Metformin</td>
<td>Can cause decrease in renal function extended release should be held the evening before surgery</td>
<td></td>
</tr>
</tbody>
</table>

### Medication Management
**Insulin Regimen**

<table>
<thead>
<tr>
<th>Type of Insulin</th>
<th>Hold</th>
<th>Give</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapid or Short Acting Insulin (Lipro or Humalog)</td>
<td>Do not give morning of procedure</td>
<td>Do not give morning of procedure</td>
</tr>
<tr>
<td>Intermediate acting (NPH and Lente)</td>
<td>Administer one-half of the usual dose</td>
<td>Do not give morning of procedure</td>
</tr>
<tr>
<td>Long Acting (Lantus)</td>
<td>Give full dose in am or if given at bedtime reduce dose by 20%</td>
<td>Do not give morning of procedure</td>
</tr>
<tr>
<td>Premixed 70/30, 75/25, 50/50</td>
<td>Give less than half of usual morning dose</td>
<td>Do not give morning of procedure</td>
</tr>
</tbody>
</table>
Surgery and postoperative care

- Intraoperative therapy
- Postoperative care and resuming therapy

Summary

Key to success in perioperative management

- Frequent blood glucose
- Maintaining optimal target blood glucose range
- Provide education
  - effects of surgery on blood glucose
  - possible complications
  - affects of glycemic control

Summary cont.

Patients actively engaged in self care will be able to

- manage glucose levels
- decrease risk of postoperative complications
- be prepared for changes to treatment plan
- be willing to accept changes to treatment plan