MAYO CLINIC

Clinical Update

Current Trends in the Practice of Medicine

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INSIDE THIS ISSUE

Advances in Elective Open and Endovascular Repair of Abdominal Aortic Aneurysms

The Challenge

In the hands of experienced surgeons, open surgical repair of an abdominal aortic aneurysm (AAA) is generally safe and provides durable results that are well suited to younger patients. During this procedure, the aorta is clamped above and below the aneurysm, and the abnormal segment is replaced with a polyester graft (Figure 1).

Perioperative complications (including cardiac and pulmonary problems, incisional hernia, sexual dysfunction, lower extremity paralysis, and death) and recovery time associated with traditional elective open repair can make this procedure less than ideal in elderly or higher-risk patients. First introduced in 1991, endovascular aortic aneurysm repair (EVAR) using a stent graft now provides a less invasive alternative to open repair. The procedure has excellent results in appropriately selected patients with good anatomy.

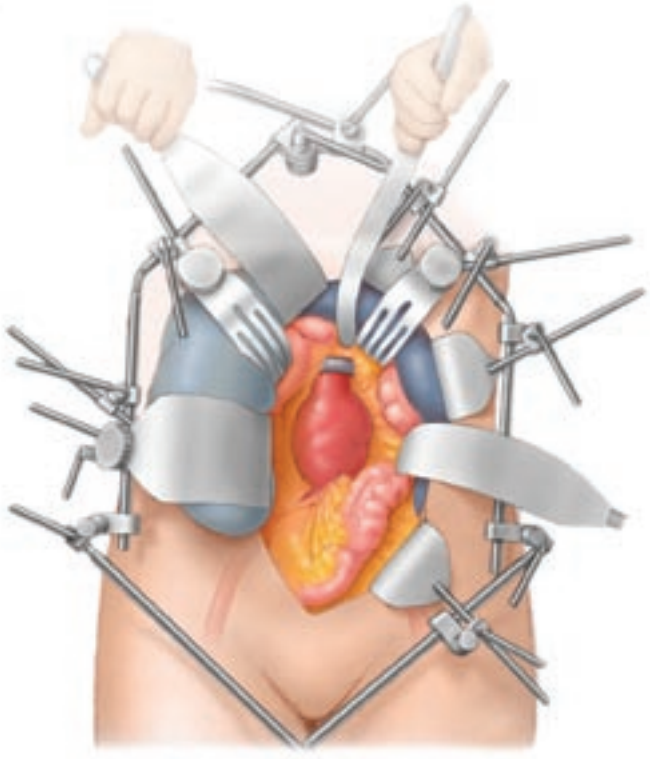

Figure 1. *Open repair of an abdominal aortic aneurysm.*

Points to Remember

- Abdominal aortic aneurysm affects an estimated 12 to 15 per 100,000 persons per year and causes considerable risk for mortality because of the potential risk of rupture.
- Screening via CT scan or ultrasound is recommended for men aged 65 years or older who have been or still are tobacco users and for men older than 50 years and women older than 60 years whose parent or sibling had an aortic aneurysm.
- Repair is recommended for aneurysms with a diameter of 5 cm or more in women and 5.5 cm or more in men, or if the aneurysm has enlarged by more than 5 mm in less than 6 months.
- Endovascular aortic aneurysm repair is the preferred treatment for patients older than 65 years, for patients who are considered to be at high risk because of other medical conditions, and for those who have undergone prior aortic operations.

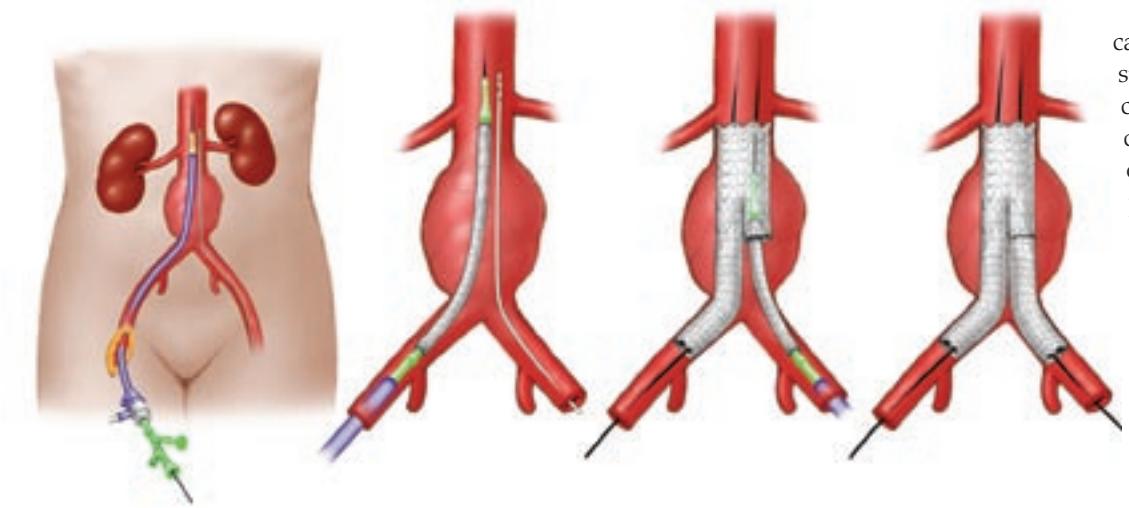

Figure 2. *Endovascular repair of an abdominal aortic aneurysm.*

Monitoring and Treatment

Aneurysms are often asymptomatic. AAAs are frequently discovered via examination of the abdomen or through an x-ray, CT scan, or ultrasound study of the abdomen performed for another purpose. If the aneurysm is small (≤4.5 cm in diameter) and there are no symptoms, monitoring annually with Doppler ultrasound is recommended. Optimal medical management should include careful control of hypertension and smoking cessation. Repair is recommended for aneurysms with a diameter of 5 cm or more in women and 5.5 cm or more in men, or if there has been growth of more than 5 mm in less than 6 months.

The groin (femoral) arteries can be exposed using small incisions or the procedure may be performed totally percutaneously. Following puncture of the femoral artery, a guidewire is passed across the dilated portion of the aorta, and the stent graft is advanced over the wire (Figure 2). Once the stent graft is correctly positioned, the device is released and the graft expands to exclude the aneurysm just below the renal arteries.

To ensure a proper seal between the stent graft and the aorta, most stents currently available require the aneurysm to have a proximal neck length of at least 1.0 to 1.5 cm below the renal arteries. However, repair can be done in patients with aneurysms that have shorter necks or no neck by using a fenestrated stent graft with side holes and branches to the renal or intestinal arteries. Suitable iliac arteries are required for introduction of the devices, although deployment through a polyester "chimney" graft sutured to the iliac artery via a small retroperitoneal incision has increased the number of candidates for EVAR.

When compared with traditional open surgical repair, EVAR offers several advantages, including decreased operative time, decreased blood loss and transfusion requirements, shorter intensive care unit (ICU) and hospital stays, and decreased risk of complications. The use of contrast has decreased, and often procedures can be performed with less than 60 mL of contrast. Operative and early (30-day) mortality are also lower for EVAR than for open repair.

The average ICU stay for open surgical repair is about 3 days, with a total hospital stay of 7 to 10 days and a postdischarge recovery time of 8 to 12 weeks. Most patients treated with EVAR no longer require admission to the ICU and are dismissed home the day after surgery. A higher percentage of patients undergoing EVAR are discharged to home rather than to nursing homes, and patients have a faster return to normal level of function, with postdischarge recovery time of 1 to 2 weeks.

Properly selected EVAR patients also have a relatively low incidence of secondary problems, but some complications specific to this technique do occur. Early conversion to open repair is exceedingly rare. Problems related to the stent graft occur in 5% to 10% of patients and require CT or ultrasound surveillance. Migration of the device is rare, with the newer-generation devices that have "hooks" or a suprarenal uncovered stent to improve fixation. And endoleaks—when blood perfuses between the stent graft and the native aorta—are reported in 5% to 10% of patients. The majority of these are type II endoleaks from a lumbar artery that continues to perfuse the aneurysm sac. These are not treated unless there is growth of the aneurysm, in which case outpatient treatment can be done using coils to exclude the lumbar artery with the patient under local anesthesia. The risk of late conversion or rupture is exceedingly low with proper imaging surveillance. For this reason, patients must be willing to comply with follow-up care that includes a CT scan of the endovascular graft 4 to 6 months after the repair and yearly thereafter. Other less common complications are stent fracture or infection.

The current prognosis for healthy patients who undergo elective aneurysm repair is excellent. EVAR represents an exciting advance in the treatment in patients with suitable anatomy and is the preferred method of treatment for elderly and higher-risk patients. Mayo Clinic's highly experienced vascular surgery team performs more than 300 aneurysm repairs annually, including complex open and EVAR procedures, making Mayo Clinic one of the largest and most experienced centers for both procedures.

Management of Mitral Regurgitation: Understanding Indications for Surgery

The Challenge

The management of mitral valve regurgitation (MR) has evolved greatly during the past 2 decades. Considerable progress has been made toward earlier diagnosis of MR to precisely quantify the severity of MR and to define clearly the cause of the MR and the prospects for valve repair in patients with severe MR. Recent research established the long-term benefits of performing valve repair before symptom onset and underscored the importance of proactive management and early surgical intervention. The risk of surgery, although very low, is a concern that leads to careful evaluation of the risk and benefit in each person affected by MR.

An Evolving Approach

Multiple studies from Mayo Clinic and other institutions have demonstrated the considerable decrease in operative risk recently and the excellent outcome of surgery performed early. An objective guideline for an early surgical decision was established by a Mayo Clinic study of 456 patients who had MR but without severe symptoms when MR was diagnosed. Five years after enrolling in this prospective study, patients with an effective regurgitant orifice (ERO) larger than 40 mm^2 who were treated only with medication had a notable risk of cardiac events and death. In those with the same severity of MR who underwent early valve repair, the risk of death or cardiac events was considerably reduced and life expectancy was restored. Since then other studies from Europe and Asia confirmed our findings and also showed considerable benefit with early surgery involving valve repair.

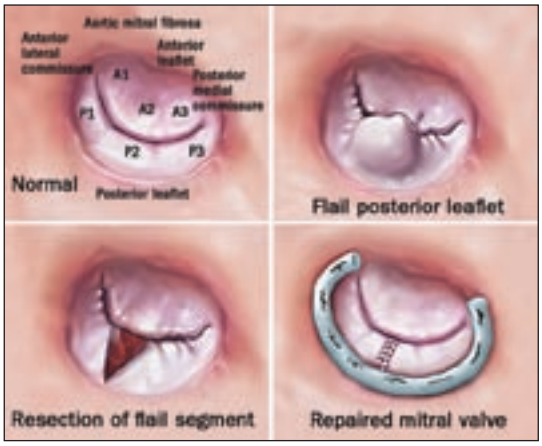

Figure 1. *Schematics of organic MR and mitral valve repair. The left upper illustration (viewed from the surgeon's point of view in the left atrium) shows a normal mitral valve with its various segments. The normal apposition of the leaflets (coaptation) appears as a "smile on the mitral face." The top right illustration shows a flail posterior leaflet. The lower (posterior) leaflet is not apposed (coapting) with the anterior leaflet, and the abnormal leaflet is prolapsing with a flail segment due to ruptured chords. Note also the anular enlargement (increased circumference). The lower left panel shows an ongoing repair with triangular resection of the flail segment of the posterior leaflet. The lower right panel shows the repair completed with insertion of an anular ring and suture of the leaflet. The mitral smile and valve competence are restored.*

Mayo Clinic's approach to treating MR emphasizes proactive assessment and management. Detailed longitudinal studies and improved techniques of 2-dimensional and Doppler echocardiography have allowed the identification of evidence-based markers for recommending mitral valve surgery in patients with severe MR. Accurate echocardiographic delineation of both the anatomic cause and the severity of MR allows selection of an optimal treatment strategy based on well-defined outcomes.

Given the benefits associated with early surgical correction, Mayo cardiologists now recommend prompt surgical evaluation for patients with classic indications (symptoms or ventricular failure) and asymptomatic patients

Points to Remember

- Affecting more than 2 million people in the United States, mitral valve regurgitation (MR) can progress in severity to a serious condition associated with excess mortality and morbidity.
- Doppler echocardiography is the main assessment tool for delineating the anatomic cause of MR and quantifying its severity.
- Surgery for severe MR, preferably valve repair, improves outcome particularly when it is done before symptom onset, marked dilation of the left heart dimension, or a decrease in ejection fraction.

with MR and
- left ventricular end-systolic dimension between 35 and 40 mm
- an ERO ≥40 mm^2
- cardiac hormonal activation
- markedly reduced functional capacity
- atrial fibrillation (even paroxysmal).

Surgical Repair vs Replacement

The long-term durability of primary and reoperative valve repair has been clearly established. At medical centers like Mayo Clinic, where surgeons perform large numbers of valve procedures on a regular basis, mitral valve repair offers several advantages over valve replacement. Successful valve repair allows patients who maintain sinus rhythm to resume full activities without the need for chronic anticoagulation.

Although the durability of mitral valve repair and replacement are similar, survival rates associated with valve repair are superior to those associated with prosthetic replacement. While patients who undergo valve replacement with a biological prosthesis usually do not require anticoagulation, their long-term need for reoperation is much higher than that of patients undergoing valve repair. Also, valve replacement with a mechanical prosthesis entails a risk of stroke that persists over the years and requires anticoagulation for life, with a notable risk of bleeding. Therefore, valve repair is the preferred method of surgical correction for patients with severe MR, and this option is the key to considering surgery before the appearance of symptoms. Mitral valve repair, performed classically by opening of the chest or through newer minimally invasive surgery, provides durability and restores life expectancy with minimal risk of morbidity. Such progress has transformed the long-term outlook of patients with severe MR.

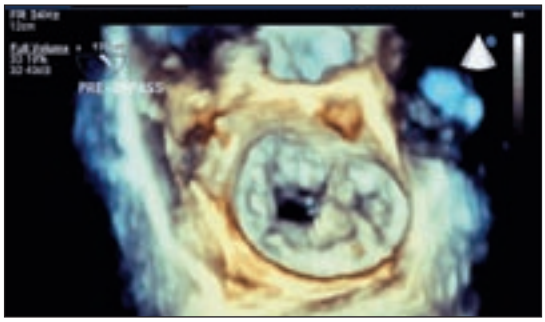

Figure 2. *Three-dimensional echocardiography of the mitral valve from the surgeon's view as in the upper right portion of Figure 1. A flail posterior leaflet is apparent with a ruptured chord.*

Robotic Approach Broadens Options for Minimally Invasive Gynecologic Surgery

The Challenge

Robotic gynecologic surgery, the most recent development in minimally invasive surgical techniques, offers many of the benefits associated with laparoscopic surgery. These benefits include decreased blood loss and transfusion requirements, fewer instances of postoperative infection, reduced postoperative pain, and shorter hospital stays and recovery periods. Surgical robots can also help overcome some of the challenges associated with conventional laparoscopy by allowing surgeons to operate with more precision and flexibility.

Laparoscopic surgery poses some well-documented challenges because surgeons must rely on 2-dimensional imaging of the surgical field and learn counterintuitive hand movements. Robotic technology overcomes many of these limitations, using 3-dimensional visualization and highly maneuverable instruments that more closely mimic the direction and movement of the surgeon's hands.

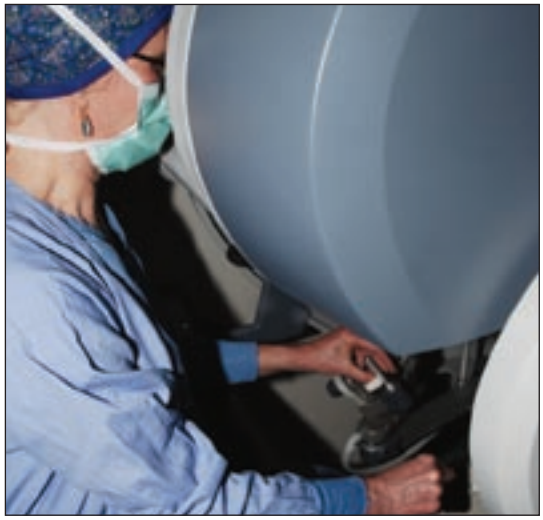

Figure 1. *While looking through binoculars equipped with a high-resolution 3-D stereoscopic imaging system, the surgeon manipulates controls inside a workstation console several feet from the operating table. These controls guide robotic endoscopic instruments docked at the operating table.*

Points to Remember

- When performed by experienced surgeons, robotic surgery overcomes some of the challenges associated with laparoscopic procedures.
- The robotic system provides 3-dimensional imaging and articulated instruments that enhance a surgeon's precision when navigating challenging anatomy.
- Mayo surgeons performed more than 400 gynecologic procedures in 2009 using the robotic approach, including hysterectomy, myomectomy, and correction of vaginal prolapse.

While looking though binoculars equipped with a high-resolution 3-D stereoscopic imaging system, the surgeon manipulates controls inside a workstation console several feet from the operating table. These controls guide robotic endoscopic instruments docked at the operating table.

The surgeon's console has the master controls that relay the exact movements of the surgeon's hands and fingers to the instruments and filter out any hand tremor (Figure 1). The surgical instruments are equipped with articulating tips and wrist mobility that improves precision. This sensitivity enhances a surgeon's ability to navigate challenging anatomy, to deftly perform microresection, and to precisely place sutures.

Surgical Indications

When performed by experienced high-volume surgeons, the robotic approach provides an effective option for a wide range of patients (Figure 2). At Mayo Clinic, gynecologic surgeons now use the robotic system to perform many complex gynecologic procedures, including hysterectomy, cancer staging operations, myomectomy (especially when preserving fertility is a goal), and correction of vaginal prolapse.

The robotic surgery option has proven effective for patients who require hysterectomy due to both benign and malignant conditions, including cervical and endometrial cancer. Additionally, robotic technology offers a minimally invasive surgical option for patients in whom vaginal hysterectomy is contraindicated by obesity or other factors. Patients who in the past traditionally required a large incision for gynecologic surgery for various reasons may now take advantage of the benefits associated with minimally invasive hysterectomy.

Although operative and anesthesia time using the robotic system can be slightly longer than those associated with traditional laparotomy and laparoscopic approaches, a dedicated team of Mayo Clinic surgeons have developed a surgical technique to optimize operating time using the robotic system. With fewer wound complications, an average hospital stay of 1 night, and patients' resumption of most normal activities within 2 weeks following surgery, the robotic approach to gynecologic surgery is quickly becoming a preferred option for many patients.

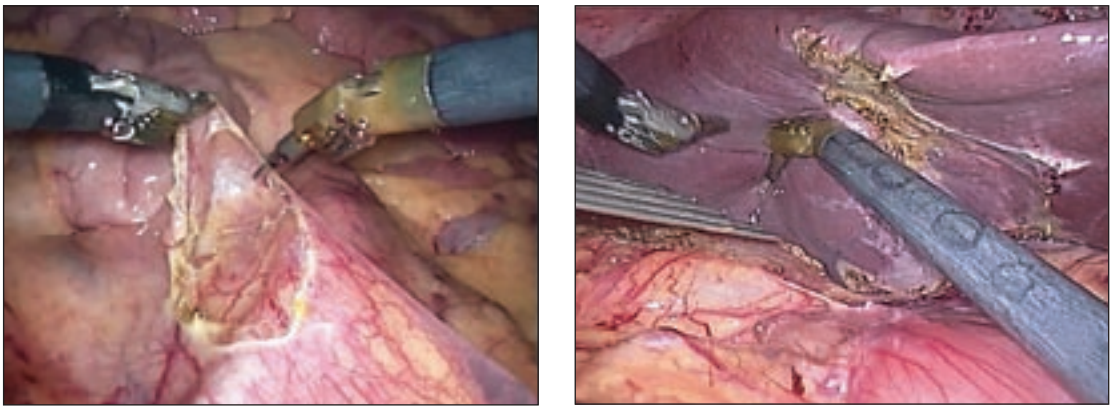

Figure 2. *Complex oncologic procedures such as para-aortic lymphadenectomy are starting to be done robotically at Mayo Clinic in Arizona. Following oncologic principles, excision of a focal infrahepatic metastatic ovarian tumor is accomplished in a minimally invasive manner using the robotic system. If the excision had not been performed robotically, this patient would have required a large incision.*

Safety and Quality Initiatives Improve Inpatient Glycemic Management

The Challenge

Optimal management of hyperglycemia in a hospitalized adult (Table) is increasingly recognized as an important therapeutic goal. Inpatient hyperglycemia has been linked to unfavorable clinical outcomes, including infection, postoperative complications, increased length of hospital stay, continued morbidity after dismissal from the hospital, and even death. In critically ill patients in medical and surgical intensive care units, effective management of hyperglycemia with intravenous insulin infusion can improve mortality and morbidity rates. However, many studies targeting glycemic control with subcutaneous insulin therapy do not focus on hospitalized patients receiving general care. Guided by recommendations from specialty organizations and a commitment to providing excellent and comprehensive care to hospitalized patients with diabetes mellitus, Mayo Clinic has implemented a number of safety and quality initiatives.

Points to Remember

- Streamlining access to consulting endocrinology staff and facilitating communication between the consulting service, primary services, and care providers can improve glycemic control in diabetic patients who present for a surgical procedure.
- Because hyperglycemic emergencies can occur on any inpatient unit, standardization of care is important to ensure that interventions are provided in an expedited manner.
- Ensuring safety and quality in diabetes medication ordering and administration is a high priority because of the increasing prevalence of hyperglycemia and diabetes in the inpatient setting and the high-risk nature of medications used to treat these conditions.

Perioperative Glycemic Management

After examining the current perioperative processes for managing the care of patients with diabetes mellitus, endocrinologists at Mayo Clinic in Rochester, Minnesota, have identified opportunities to improve glycemic control, and they have developed an efficient system for providing care to diabetic patients who present for a surgical procedure.

The revised process requires the surgeon to identify a patient with diabetes when listing the patient for surgery. The surgeon then has the option to consult the Diabetes Consulting Service (DCS) for perioperative glycemic management and recommendations on homegoing instructions, including blood glucose monitoring and outpatient follow-up (Figure).

Streamlining the perioperative process for a patient with diabetes has provided practice consistency, clear delineation of care providers' roles, and improved communication among surgical areas, primary services, and DCS.

Treatment of Hyperglycemic Emergencies

Hyperglycemic emergencies related to diabetes present with a constellation of associated metabolic abnormalities. Standardization of care in response to hyperglycemic emergencies is important to ensure that interventions are provided in an expedited manner. To accomplish this goal, Mayo Clinic endocrinologists developed an order set for treatment of adult patients with diabetic ketoacidosis or hyperglycemic hyperosmolar state. Providing guidelines for diagnosis, monitoring, and care of patients with either condition, the order set is initiated in the emergency department and continued in the inpatient unit.

Computer-Based Monitoring System

Various care providers manage diabetes in patients receiving diabetes-related medications in

Table. *Premeal Glycemic Targets for the Adult Hospitalized Patient*

Patient Group	Glycemic Target, mg/dL		
	ADA	ACE	Mayo Clinic in Rochester
Critically ill	Approximately 110	<110	80-130
Noncritically ill	90-130	<110	80-150

Abbreviations: ACE, American College of Endocrinology; ADA, American Diabetes Association.

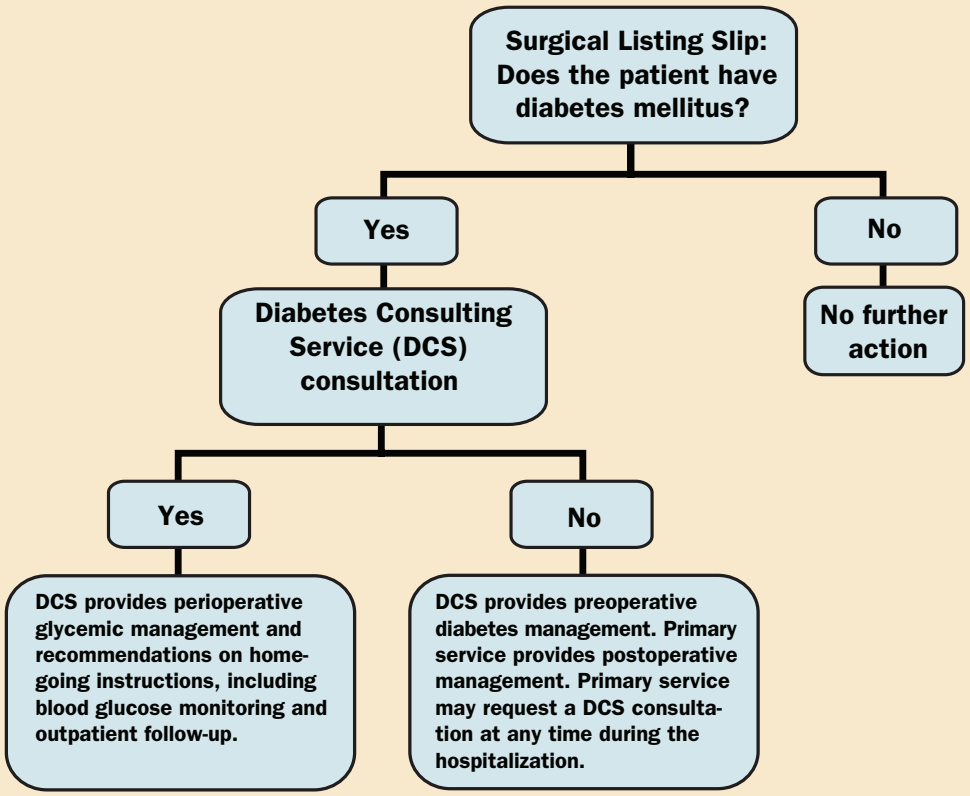

Figure. *Optimal perioperative process for the patient with diabetes mellitus.*

the hospital setting. To offer oversight for safe and effective diabetes management, Mayo Clinic endocrinologists implemented a computer-based medication monitoring system for the hospital setting. A series of simple "rules" related to diabetes medications, glucose monitoring, and blood glucose levels were programmed and applied to a series of databases. When the conditions of a rule are met, a report is generated for follow-up. The reports are monitored daily, and providers are contacted with suggestions to improve patient safety or glycemic control, or both. This system has been well received by health care providers and should improve glycemic control, promote appropriate and safe insulin use in the hospitals, and improve quality of care.

Management of Continuous Subcutaneous Insulin Infusion Pumps in the Hospital

Managing the care of patients with a continuous subcutaneous insulin infusion (CSII) pump admitted to the hospital is particularly challenging for providers without diabetes expertise. Because providers and patients possess varying degrees of experience in managing diabetes with an insulin pump, Mayo Clinic endocrinologists developed a policy that describes management of a CSII pump in the hospital. DCS staff see all patients who want to continue using their CSII pump during their hospitalization to assess the patient's recent glucose control and ability to manage the pump. For hospitalized patients who continue to use the CSII pump, the policy provides guidance for insulin ordering, glucose testing, pump refills, site changes, and documentation of pump rates. DCS staff observe patients closely throughout their hospital stay to determine their continued ability to self-manage the pump and whether adjustments to pump rates are required. Many of these safety and quality initiatives developed to improve inpatient glycemic management at Mayo Clinic are appropriate for use at other medical centers as well.

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Clinical Update

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