

The Diabetic Surgical Patient

ZSA ZSA CHINN, CST

Every five minutes, two people die from diabetes-related causes and 16 adults are newly diagnosed.⁶ The Centers for Disease Control (CDC), reports that the total direct and indirect cost of diabetes in 2012 was \$245 billion.⁶ All people struggling with this condition have the same physiological, mental and emotional stressors and mind-sets. Uncontrolled blood glucose (BG) levels damage the bodies of those who are affected by this condition, and as a result, diabetic patients undergo surgical procedures at a higher rate than non-diabetic people. Due to these complications, "it is imperative that conscientious attention be paid to the metabolic statue of patients before, during and after surgical procedures."⁴

his article will include a brief and basic review of anatomy and physiology, and discuss the causes, management and complications of type 1 diabetes mellitus (T1DM), type 2 diabetes mellitus (T2DM), gestational diabetes mellitus (GDM) and pre-diabetes, as well as a discussion of pre-, intra- and post-surgical insulin management in order to avoid surgical complications for the diabetic patient. As a surgical team member, learning about this common disease and its conditions, will provide the surgical technologist with valuable knowledge, understanding and awareness so they may provide superior patient care.

ANATOMY AND PHYSIOLOGY

The digestive tract and accessory organs break down consumed food for energy. The digestive anatomy includes the stomach and small intestine, and the accessory organs include the liver and pancreas.

LEARNING OBJECTIVES

- Review the different types of diabetes
- Learn about how diabetes affects one's anatomy and physiology
- Recall the special considerations when operating on a diabetic patient
- List the complications that diabetes can cause
- Explore neuropathy and how it affects diabetics

They all lie below the diaphragm in the right, left and middle upper quadrant of the abdomen. The stomach lies in the middle-left upper quadrant; the small intestine, specifically the duodenum, lies in the right-mid quadrant; the liver lies behind the ribcage in the right mid to right upper quadrant with the gallbladder attached to its underside; and the pancreas lies behind the stomach in the middle-left quadrant of the abdomen with the head nestled below the greater curvature of the stomach, under the liver and gallbladder area, and against the duodenum. The liver and the pancreas connect to the duodenum of the small intestine, via the common bile duct and the pancreatic duct, which forms the duodenal ampulla.⁵

As food is chewed and swallowed, it moves from the mouth, through the laryngopharynx, into the esophagus and down into the stomach where it is acidified for easier protein digestion. Microbial destruction and secretion of pepsin, bile and pancreatic enzymes occur, chyme is created. As the chyme enters the small intestine, it undergoes chemical and mechanical digestion and absorption. The metabolism of this food causes many other complex processes to take place and the end result – about an hour after food consumption – has glucose flowing in the bloodstream. According to the National Institutes of Health (NIH), a healthy person's pancreas responds to post-meal BG levels by releasing insulin into the blood stream.⁷

Insulin, made by beta (β) cells in the pancreas, lowers BG levels in different ways. It helps muscle, fat and liver cells absorb glucose from blood; it stimulates the liver and muscle tissue to store glucose as glycogen; and insulin lowers BG levels by reducing glucose production in the liver⁷. On the flip side, if BG levels drop - say during overnight sleep, a skipped meal or with heavy exercise - glucagon, made by alpha (α) cells in the pancreas, raises BG levels. This can occur in two ways: when glucagon signals the liver and muscle tissue to break down glycogen into glucose, which then enters the bloodstream, and when glucagon stimulates the liver to make glucose from amino acids.7 The bodies of people with diabetes are unable to function in this manner. Some of the reasons that interfere with these functions are autoimmune malfunction induced by genetic mutation, stress on the body physiology created by viruses, illness and being overweight or obese.

Type 1 diabetes (T1DM) is an autoimmune disease where the immune system attacks and destroys β -cells, housed inside islet cells, in the pancreas. Specific T-cells, white blood cells (WBC), are primed to attack these specialized insulin producing cells.⁷ Research from the NIH shows there have been gene variants identified that carry instructions for making a protein, called human leukocyte antigen (HLA), on those specific WBCs. These gene variants are linked to the risk of developing T1DM. However, some HLA-produced proteins help the immune system see the WBCs as part of the body, thus refraining from cellular destruction, while other proteins do nothing.⁷ Scientists are unclear as to why this occurs. Although there currently is genetic testing is being done, there is no available cure for individuals who possess these genetic variants, and nothing has been found to improve prevention nor treatment for T1DM.⁷

Uncontrolled blood glucose (BG) levels damage the bodies of those who are affected by this condition, and as a result, diabetic patients undergo surgical procedures at a higher rate than non-diabetic people.4 Due to these complications, "it is imperative that conscientious attention be paid to the metabolic statue of patients before, during and after surgical procedures."⁴

Some scientists theorize environmental reasons that prompt autoimmune damage of beta cells in people with genetic susceptibility.⁷ Viruses and or infections also have been considered and theorized as a possible culpet.⁷ The onset of T1DM occurs more in winter months, when viral infections are more common and other people are sometimes diagnosed during or after a viral infection. Viruses common to T1DM diagnosis include coxsackievirus B, cytomegalovirus, adenovirus, rubella and mumps. Although these conditions don't cause diabetes, antibodies to islet cells and beta cell damage – which can cause pancreatitis from congenital rubella syndrome – have been found in patients with these viruses.⁷ Other chronic non-curable diseases or issues with the pancreas can cause T1DM such as pancreatitis, tumors and pancreatectomy (due to cancer).⁷

Recent research has considered insulin to be a trigger

Types of Diabetes



in the immune attack on beta cells, as the immune systems of people who are genetically vulnerable to develop T1DM respond to insulin as if it were a foreign substance or antigen. Patients with T1DM produce antibodies to combat the antigens to insulin and other proteins produced by β -cells. Testing for these antibodies can identify people with an increased risk of developing diabetes and determine the type or kind of diabetes.⁷

Knowing the correct type of diabetes is imperative. Daily care for the person that has islet cell destruction, one who does not make insulin, includes precisely measured insulin injections via syringe and a needle or an insulin pump. Other routines include management of diet and exercise as these are the best ways to maintain weight and strictly controlled BG levels.

Type 2 diabetes (T2DM) is the most common form of

diabetes in the United States. It is a disease where the body is resistant to insulin or where there is β -cell dysfunction. In this type of diabetes, the body's muscle, fat and liver cells do not use insulin effectively. Overweight and obese people – including children and adolescents – are most susceptible to acquiring this type of diabetes. Diagnosis of T2DM used to be more commonplace in middle-aged patients; however, with the rise in obesity in children and adolescents, it now affects these age groups at a higher rate. African Americans, Alaska Natives, American Indians, Asian Americans, Native Hawaiians, Pacific Islander Americans and Hispanic/Latinos are diagnosed more frequently than Caucasian/White Americans.⁷

Scientists have found gene variants that increase a person's susceptibility where these genetic mutations affect insulin production versus insulin resistance. Inheriting a

Diabetes Symptoms

Increased thirst, frequent urination, hunger, fatigue and blurred vision are common symptoms for both Type 1 and Type 2



Diabetes Care

Lifestyle changes with diet, exercise and medication allow patients to manage their condition

Prevention

A low-fat, low-carbohydrate diet and plenty of exercise can help prevent the development of Type 2 diabetes

mutation from each parent increases a person's risk 80%

group of conditions experienced by the afflicted patient that also increases the risk of developing T2DM. These conditions include higher than normal BG levels, increased waist size from excess abdominal fat, high blood pressure and abnormal levels of cholesterol and triglyceride blood levels.⁷ Furthermore, as with T2DM, people can have this for years and not know it.

Gestational diabetes (GDM) occurs during pregnancy. Insulin resistance, caused from hormones produced by the placenta and other pregnancy-related factors, can occur

more than for those with no genetic inheritance; however, these gene variants are uncommon for this type of diabetes. Genetic conditions, such as Down and Cushing syndromes, also can account for T2DM. Other times, diabetes may occur in cases where the body is physiologically stressed such as injury or septicemia. In these cases, normal body function generally returns when the injury or infection has healed or cured.⁷

Metabolic syndrome or insulin resistance syndrome is a

during late pregnancy. If the pancreas is unable to produce enough insulin due to β -cell dysfunction, GDM occurs. Women who are overweight or obese prior to pregnancy are especially susceptible to this type of diabetes due to the pregnancy starting out with a high need for insulin due to its resistance.⁷ This effect is similar to T2DM. There also is an increased risk of GDM in subsequent pregnancies with women diagnosed with GDM, along with high-infant birth weight. Children born to mothers diagnosed with gestational diabetes are more susceptible to childhood and adult obesity, T2DM and GDM (if the child is female). Genetic variance also may occur with GDM, however, it's a low-risk factor. Gestational diabetes usually resolves post-partum, but the BG levels of mother and baby still will need to checked following the birth.⁷

MANAGING DIABETES

Management of the diabetic patient is the same regardless of type. Upon diagnosis, education is paramount. Diabetic patients will need to learn about and adopt persistent BG monitoring so they may come as close to a non-diabetic as possible. Patients will need to learn about medications, diet, exercise and illnesses. They will need to learn and know how uncontrolled or high BG levels can have negative effects and affects on their body functions. T1DM patients will need to learn safe and proper injection techniques and sites for administration of insulin. They will need to learn when and how to take long-acting and short-acting insulins.¹

It is suggested that patients receive support from multiple sub-specialties, including dietitians and nutritionists, primary care members, podiatrists, cardiologists and nephrologists. Together, these professionals can assist patients with continuous techniques for obtaining persistent blood glucose monitoring and control, and encourage compliance with proper eating and exercise, which ultimately helps to create the best outcomes for the patient. These actions help to reduce the many complications – high blood pressure, hyperlipidemia, kidney disease, cataracts and other eye problems, genitourinary problems and integumentary issues – for the diabetic patient.

Depression is an extremely common complication that diabetic patients suffer from. It affects all diabetics for various reasons and at various times. Mental and emotional stress due to work or school can trigger hyperglycemic incidents, and a simple cold can render blood sugar levels uncontrollable before the patient seeks treatment and for days to weeks following the illness. More serious health issues such as surgery or an amputation can place an extreme amount of physiological, psychological and physical stress on the patient. These, as well as other more serious complications, can trigger bouts of depression, which have adverse effects on how the patient cares for their own insulin, diet and exercised needs.

One of the worst complications for diabetics is neuropathy. The NIH reports that neuropathy is found in 60 to 70 percent of diabetics.⁸ Nerve damage affects every organ of diabetics, and the highest risk factor for development is uncontrolled BG, age and duration of diabetes.⁸ Patients who are older and have had the condition for 25 years or more have the highest risk for development of neuropathy.⁸

Type 2 diabetes is the most common form of diabetes in the United States. It is a disease where the body is resistant to insulin or where there is D-cell dysfunction. In this type of diabetes, the body's muscle, fat and liver cells do not use insulin effectively.

There are different types of neuropathy affecting different parts of the body. Peripheral neuropathy affects the extremities including the hand, fingers, feet and toes. Autonomic neuropathy affects the heart, lungs and blood vessels, digestive and urinary systems, as well as the sweat glands and sex organs. Proximal neuropathy affects areas in the central body, including the thighs, hips, buttocks and legs. Focal neuropathy affects areas such as the eyes, ears and facial muscles, pelvis and lower back, chest and abdomen and the thighs, legs and feet.⁸

It is not completely understood how nerve damage occurs in the body. Combinations of factors contributing to neuropathy include metabolic issues such as high BG, abnormal blood fat levels and possibly low levels of insulin. Neurovascular changes affecting transportation of oxygen and nutrients to body tissues, and waste products away from tissues, is another element in developing nerve dam-

INSULIN AND GLUCAGON regulate blood glucose levels



age.⁸ Specifically, more than 60% of all non-traumatic lower-limb amputations in the United States occur in people with diabetes.⁷ This is due to the fact that nerves to the feet are the longest in the body and, therefore, are affected the most.⁸

As with most surgeries, it is used to cure a disease or physical abnormality, reduce or resolve pain or make a diagnosis. Major surgery is defined as requiring general anesthesia for more than 1 hour with minor surgery requires general anesthesia for as long as one hour.⁴ *Diabetes Spectrum* reports,

> "Surgery on the diabetic patient poses difficult obstacles for the patient, the involved medical [and surgical] teams, and the patient's respective communities. The stress response (itself) to a surgical procedure may precipitate diabetic crises, diabetic ketoacidosis (DK), or hyper glycemic hyperosmolar syndrome (HHS) can happen during surgery or post-operatively, with negative prognostic consequences."

HHS is a well-known postoperative complication following certain procedures. In cardiac surgery it is associated with a mortality rate of 42%.⁴ According to Dagogo-Jack and Alberit,

"It is therefore imperative that care-

ful attention be paid to the metabolic status of people with diabetes undergoing surgical procedures. Insulin resistance induced by circulating stress hormones, surgical stress has a deleterious effect on pancreatic beta cell function; during surgery plasma insulin levels fall and insulin secretory responses to glucose become impaired."

The activation of counter-regulatory hormones is epinephrine and norepinephrine. Simplified, these postoperative problems correlate to low insulin levels, insulin resistance, and most threatening, excessive destruction (catabolism) of glucose homeostasis. This response happens to all diabetic patients, and most need insulin therapy preoperatively.⁴

"Management of all patient with T1DM having minor or major surgery and patients with T2DM enduring major surgery are suitable candidates for intensive peri-operative diabetes care. Fasting and intraoperative glucose monitoring is recommended, especially if the surgical procedure is major. Methodologies in this category of patients always include insulin therapy with a combination of dextrose and potassium infusion."

A T2DM patient with well-controlled BG may not require this intervention. Once eating is resumed following minor surgical procedures, most medications can be restarted.⁴ Chuah et al report "Diabetic patients are more at risk of poor wound healing, respiratory infection, myocardial infarction, admission to intensive care and increased hospital length of stay; this creates increased inpatient costs."

SURGERY AND THE DIABETIC PATIENT

The above information may not be known by the surgical technologist, so being aware of these practices affords them understanding and allows participation in exceptional care of the patient on the operating table. With the rise of T2DM, bariatric surgery also has increased as a cure.² T2DM cardiac patients have a longer hospital stay, higher healthcare resource utilization and greater perioperative morbidity than non-T2DM patients.² Chuah et al report, in part, "... the two-year risk of myocardial infarction, following drug-eluting or bare metal stents, is 6.9% higher in T1DM." These patients also have more than two times greater the incident of postoperative death in CABG than non-T2DM; 3.9% versus^{1.6.2} A vast variety of surgical procedures related to diabetic complications include: CABG; revascularization of limbs through grafting (auto, synthetic or donor); endarterectomies; embolectomy; amputation of necrotic and or infected extremities; catheter insertions for temporary dialysis due to acute renal failure (usually due to systemic infection); and AV fistula creation for permanent renal dialysis due to chronic renal failure (usually due to high blood pressure, neuropathy or both). Also common for T1DM patients are D&C or D&S for multiple miscarriages.⁷

When performing a surgery on a diabetic patient, a surgical technologist needs to be aware of their body relative to the patient's body. A surgical tech needs to avoid unnecessary leaning or pressure on the diabetic patient during surgery. Other routines may include covering a diabetic's fingers and toes during the procedure. This is due to the

One of the worst complications for diabetics is neuropathy. The NIH reports that neuropathy is found in 60 to 70 percent of diabetics.⁸ Nerve damage affects every organ of diabetics, and the highest risk factor for development is uncontrolled BG, age and duration of diabetes.⁸

higher microbial count under the diabetic's nails. A surgeon's preference will dictate how best to deal with this issue, although one of the cheapest ways is to use a glove.

Surgical technologists will need to be aware of blood glucose monitoring. Intraoperative glucose monitoring will be obtained via a blood glucose machine and there are many different types used. The common standard practice is to monitor it every hour of surgery.⁴ Surgical technologists should know prior to the operation where these machines are stored.

Since diabetics experience greater infection rates, serial surgical procedures is not uncommon. Many of these patients are severely ill, their body systems including their integumentary systems are comprised. Surgical preparation for the diabetic patient will include adequate padding on their limbs to prevent skin tears. The surgical technologist needs to avoid excess pressure or abrasion. The surgical technologist will need to coordinate with the surgeon on how to cover and maintain sterile technique if the patient has an insulin pump insertion site close to the incision site.

According to researchers at the University of Michigan, 50 percent of patients with diabetes were more likely to develop a surgical site infection (SSI) than patients without the condition, with SSIs occurring in roughly four percent of all surgeries.9 The exact reasons are not known, but the researchers noted "... it is possible that diabetes is a marker for other conditions that may put a patient at risk of infection, including vascular changes and white blood cell dysfunction."9

Following the operation, diabetics will need to continue to monitor their glucose levels and maintain quality nutrition to help control infection. It is encouraged that diabetics continually check for an elevated temperature in case signs of infection are not apparent. General signs of a wound infection include: foul drainage, fever greater than 101 degrees, an incision that feels hot or is very red, pain around the incision site that gets worse and swelling of the incision site.

ing, watching movies, traveling and visiting with her four adult children. She is currently finishing her prerequisites for entry into nursing school.

REFERENCES

- 1. Adjusting Basal and Bolus Insulin Doses. (2015). Diabetes.co.uk, the Global Diabetes Community: http://www.diabetes.co.uk/insulin/adjustingbasal-bolus-insulin-doses.html. Accessed July 15, 2015.
- 2. Chuah, LL.; Papamargartitis, D; Krishnamoorthy, A; le Roux, CW. Morbidity and mortality of diabetes with surgery. Nutr Hosp. 2013;28(2):47-52.
- 3. Copestead, LB. (2010). Pathophysiology, 4th ed. St. Louis: Saunders.
- 4. Dagogo-Jack, SA; Alberti, KGMM. Management of Diabetes Mellitus in Surgical Patients. Diabetes Spectrum. 2002 Jan; 15(1):44-48.
- 5. Kapit, WE. (1993). The Anatomy Coloring Book. New York: HarperCollins.
- 6. National Diabetes Statistics Report: Estimates of Diabetes and Its Burden in the US. (2014). Centers for Disease Control and Prevention: http://www. cdc.gov/diabetes/pubs/stats report 14/national-diabetes-report-web.pdfAccessed July 15, 2015.
- 7. National Institutes of Diabetes and Digestive and Kidney Diseases. (June 2014). National Institutes of Health: http://www.niddk.nih.gov/healthinformation/health-topics/Diabetes/causes-diabetes/Pages/index.aspx. Accessed July 15, 2015.
- 8. National Institutes of Diabetes and Digestive and Kidney Diseases. (November, 2013). http://www.niddk.nih.gov/health-information/healthtopics/Diabetes/diabetic-neuropathies-nerve-damage-diabetes/Pages/ diabetic-neuropathies-nerve-damage.aspx. Accessed July 15, 2015.
- 9. Diabetes patients more at risk of surgical site infections, research finds. (2015). Diabetes.co.uk, the Global Diabetes Community: http://www.diabetes.co.uk/news/2015/oct/diabetes-patients-more-at-risk-of-surgicalsite-infections.html. Accessed July 15, 2015.



ABOUT THE AUTHOR

Zsa Zsa Chinn, CST, has been practicing as a tech in Yakima, Washington, for the last four years. Prior to that, she practiced for 11 years in Spokane. When she is not in the OR, she enjoys garden-

504 The Surgical Technologist NOVEMBER 2016

AUTHOR'S NOTE Diabetes is personal to me. My mother passed away at age 53 from complications after a 42-year history with T1DM. My sister found out several months following the birth of her first child that she had T1DM; she was 26 years old at the time. She is currently experiencing complications related to neuropathy. Depression, chronic and sometimes debilitating pain, and gastroparesis are just a few problems she deals with on a daily basis. At 46, she is unable to have a job.

I was diagnosed with gestational diabetes during my second pregnancy. Both my children weighed 9lbs 8oz at birth – one born on the due date, the other born seven days before the due date. I know I will become Type 2 someday, and it's just a matter of time. I am also overweight. While researching for this article, I realized I needed to do something, and for the first time, I told my doctor (at a July appointment) that I wanted to do something about my weight. He is holding me accountable. In early August, I joined my local YMCA and now workout three days per week. By paying attention to my diet and exercise, I lost 12 pounds in about four weeks. I feel better, I am more clear-headed and I have more energy.

The Diabetic Surgical Patient

#395 **NOVEMBER 2016** 2 CE credits \$12

- 1. Insulin lowers BG levels by reducing glucose production in the _____.
- a. Pancreas
- **b.** Stomach
- **c.** Small intestine
- **d**. liver
- 2. Type 1 diabetes is an autoimmune disease where the immune system attacks and destroys:
- a. Islet cells
- **b.** Pancrease
- c. B-cells
- d. T-cells

3. The onset of T1DM occurs more in the

- a. Winter
- **b.** Spring
- c. Summer
- d. Fall

4. Which form of diabetes is the most common in the US?

- a. Type 1
- **b.** Type 2
- **c.** Gestational
- **d.** All of the above

5. In T2DM, the body is resistant to

- **a.** WBCs
- **b.** Antigens
- c. Insulin
- d. B-cells
- 6. Inheriting a mutation gene from each parent increases a person's risk by ____ of getting diabetes.
- **a.** 50%
- **b.** 60%
- **c.** 70%
- **d.** 80%

7. Gestational diabetes occurs _____.

- **a.** In middle age
- **b.** During pregnancy
- Following an operation C.
- **d.** In youth
- 8. One of the worst complications for dia-

- c. Cataracts

- 9. Of all the non-traumatic lower-limb amputations performed in the US, ____ occur in people with diabetes.
- **a.** 60%
- **b.** 65%
- **c.** 70%
- **d.** 75%

10. Due to the higher microbial count under a diabetic's nails, what may be covered during a surgical procedure?

- **a.** Arms and legs
- **b.** Arms and fingers
- **c.** Fingers and toes
- d. Toes and legs

THE DIABETIC SURGICAL PATIENT #395 November 2016 2 CE CREDITS \$12

NBSTSA Certification No.			.		b	С	d
AST Member No.				1			
□ My address has changed. The address below is the new address.				2			
Name			_	3			
Address				4			
City	State	Zip		5			
Telephone			-	6			
Check enclosed Check Number		-	7				
Visa MasterCard American Express		-	8				
Credit Card Number			9				
			-	10			
EXPIRATION DATE							

NOVEMBER 2016 The Surgical Technologist 505

of this benefit.

Make It Easy - Take CE

You must have a credit card to purchase test online. We accept Visa, MasterCard and American Express. Your credit card will only be charged once you pass the test and then your credits will be automatically recorded to your account. Log on to your account on the AST homepage to take advantage

Exams Online

- betics is _____.
 - **a.** Depression
 - **b.** Neuropathy
 - **d.** Kidney disease



Earn CE Credits at Home

You will be awarded continuing education (CE) credits toward your recertification after reading the designated article and completing the test with a score of 70% or better. If you do not pass the test, it will be returned along with your payment.

Send the original answer sheet from the journal and make a copy for your records. If possible use a credit card (debit or credit) for payment. It is a faster option for processing of credits and offers more flexibility for correct payment. When submitting multiple tests, you do not need to submit a separate check for each journal test. You may submit multiple journal tests with one check or money order.

Members this test is also available online at *www.ast.org.* No stamps or checks and it posts to your record automatically!

Members: \$6 per credit (per credit not per test) Nonmembers: \$10 per credit (per credit not per test plus the \$400 nonmember fee per submission)

After your credits are processed, AST will send you a letter acknowledging the number of credits that were accepted. Members can also check your CE credit status online with your login information at *www.ast.org.*

3 WAYS TO SUBMIT YOUR CE CREDITS

Mail to: AST, Member Services, 6 West Dry Creek Circle Ste 200, Littleton, C0 80120-8031

Fax CE credits to: 303-694-9169

E-mail scanned CE credits in PDF format to: memserv@ast.org

For questions please contact Member Services *memserv@ast.org* or 800-637-7433. Business hours: Mon-Fri, 8:00a.m. - 4:30 p.m., MT

