1 CEU

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THE NATIONAL CONTINUING EDUCATION PROGRAM FOR PHARMACY TECHNICIANS

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FREE CE FOR TECHNICIANS

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Instructions

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Diabetes: Treatment of hyper- and hypoglycemia

By Dorothy Pardalis, BSc. Phm, C.A.E.

Statement of objectives

Upon completion of this lesson, the pharmacy technician will be able to:

1. **Understand the prevalence and types of diabetes.**
2. **Understand that uncontrolled diabetes can lead to serious long-term complications.**
3. **Understand the target ranges for blood glucose.**
4. **Recognize the risk factors, symptoms, blood glucose values and treatment for hyperglycemia and hypoglycemia.**
5. **Recognize and refer patients who require assistance or extra care for their diabetes to the pharmacist.**

Introduction

According to the World Health Organization, an estimated 300 million people around the world will have diabetes by the year 2025. Currently, more than two million Canadians have the disease.[1]

Diabetes makes it difficult for the body to convert food into energy. After food is ingested, it is broken down into glucose (sugar), which is then transported to the cells through the bloodstream. Insulin, a hormone produced by the pancreas, allows the cells to convert blood glucose into energy. When insulin is insufficient or cannot be used properly, glucose can't enter the body's cells, causing glucose levels to rise in the blood. If diabetes is not managed and glucose is left high and uncontrolled, damage can occur to the body's nerves and blood vessels, which may result in heart, kidney and eye disease, stroke, nerve problems, impotence or amputation.

There are three main types of diabetes: type 1, type 2 and gestational diabetes.

In type 1 diabetes, the pancreas does not produce any insulin at all. Patients with type 1 diabetes must rely on insulin injections. Approximately 10 per cent of people with diabetes have type 1 diabetes, which is generally diagnosed before the age of 40, and often during childhood. In type 2 diabetes, the pancreas may not be able to produce enough insulin and/or the body is unable to effectively use the insulin that is produced. Approximately 90 per cent of people with diabetes have type 2 diabetes. In gestational diabetes, women develop diabetes temporarily during their pregnancy. Their body's requirement for more insulin can be attributed to the growing baby's glucose needs as well as hormones produced by the placenta that may block the effect of insulin. Approximately 3.5 per cent of all pregnancies will result in gestational diabetes. Most pregnant women are screened between the 24th and 28th week of pregnancy for gestational diabetes.

Type 2 diabetes is a major public health concern. Contributing factors in its increased incidence include: the aging population, higher obesity rates, lack of physical activity, immigration by high-risk populations and growth in the aboriginal community (see risk factors for hyperglycemia on page 2).[2] Due to the serious nature of diabetes complications, as well as the growing number of people who suffer from the disease, it is critical that healthcare professionals diagnose and treat diabetes, and help people with diabetes manage their condition.

Patients with diabetes visit the pharmacy often to pick up medications and supplies; therefore, many opportunities

exist for the pharmacy team to talk to patients about their diabetes and assist them in achieving their health goals. In this article, we will focus on the most prevalent type of diabetes: type 2 diabetes.

Controlling of blood glucose

When screening for diabetes, a patient's physician may order a fasting blood glucose test (no caloric intake, from food or drink, for at least 8 hours before the test). If the results are greater than or equal to 7.0 mmol/L, the patient has diabetes. Physicians will also pay close attention to a fasting blood glucose of 6.0 to 7.0 mmol/L as these patients are at high risk of developing diabetes. These "pre-diabetic" patients should be advised to make lifestyle modifications such as healthy eating and doing physical activity to lower their blood glucose levels.

Studies clearly show that the long-term complications of diabetes can be reduced by controlling blood glucose in a tight range.[3] Glycosylated hemoglobin (A1C, formerly referred to as HbA1c) is a simple blood test ordered by physicians that measures the average blood sugar level over the past three months. A1C can help physicians determine if a patient is in good control or at risk of long-term complications.

To help patients keep their blood sugar in the desired range and decrease their risk of long-term complications, encourage them to self-monitor their blood glucose at home throughout the day. Since blood glucose is affected by a patient's food choices, level of physical activity and medications, home glucose monitoring assists patients to determine whether their sugars are in the target range. Together with their healthcare team, patients can then adjust their lifestyle and medication in response to these blood glucose levels.

The pharmacy team has a very important role in helping to identify the appropriate blood glucose monitor to meet a patient's needs and teaching the patient how to use it effectively. For patients with type 1 diabetes, testing blood sugar at least three times daily is recommended to achieve tight control. The optimal testing frequency for patients with type 2 diabetes is unclear and may vary from person to person. However, studies show that patients with type 2 diabetes who test at least once daily will attain tighter blood glucose control.[2]

Ideally, blood sugar should be tested at various times throughout the day, including during a fasting state or empty stomach, (e.g. morning before breakfast) and two hours after a meal (e.g. two hours after dinner).

The target ranges of blood glucose for people with diabetes must be individualized for each patient in collaboration with their healthcare team. Recommended targets are listed in Table 1.[2]

Table 1: Recommended target ranges of blood glucose[3]

	A1C (%)	Fasting blood glucose (mmol/L)	Blood glucose 2 hours after a meal (mmol/L)
Target range for most patients with Type 1 or Type 2 diabetes	< 7.0	4.0 - 7.0	5.0 - 10.0
Normal range (may be unsafe target for some patients)	< 6.0	4.0 - 6.0	5.0 - 8.0

A1C = glycosylated hemoglobin

Hyper- and hypoglycemia are the two extreme undesirable states of blood sugar levels. They also share some symptoms. It is critical to know which state a patient is experiencing to provide effective treatment and bring blood glucose levels back to the normal range.

Hyperglycemia

Hyperglycemia is defined as higher than normal levels of glucose in the blood. Hyperglycemia occurs in people with diabetes because of decreased insulin production and/or inefficient use of insulin. Generally, hyperglycemia occurs when blood glucose values are greater than 7.0 mmol/L in a fasting state or greater than 10 mmol/L two hours after eating a meal.

Risk Factors

The following factors place patients at risk of developing hyperglycemia and type 2 diabetes:

- Over 40 years of age;
- Aboriginal, Hispanic, Asian, South Asian or African descent;
- Overweight;
- Inactivity;
- Parent or sibling with diabetes;
- Gestational diabetes or giving birth to a baby larger than 4 kg (9 lbs);
- High blood pressure; and
- High blood cholesterol.

Symptoms

Symptoms of hyperglycemia may include:

- frequent urination;
- increased sweating;
- trembling;
- excessive hunger;
- excessive thirst;
- dizziness;
- inexplicable fatigue;
- irritability;
- confusion; and
- blurry vision.

Patients who experience such symptoms should be referred to a physician

A rare and serious complication of hyperglycemia is diabetic ketoacidosis (DKA). DKA occurs when insulin is extremely low and blood sugar is extremely high. The body reacts by breaking down fat into ketones, which make the blood acidic.

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Pharmacy PRACTICE

Table 2: Some medications that can cause or aggravate hyperglycemia[4]

Corticosteroids (e.g. prednisone)
Diuretics (e.g. hydrochlorothiazide)
Protease inhibitors
Diazoxide
Cyclosporine
Atypical antipsychotics (e.g. olanzapine)
Niacin

Table 3: Some medications that can cause hypoglycemia[5]

Salicylates (e.g. Aspirin) > 4g / day
Sulfonamide antibiotics (e.g. sulfamethoxazole)
Tricyclic antidepressants (e.g. amitriptyline)
Warfarin
Fibrates (e.g. fenofibrate)
Monoamine oxidase inhibitors (e.g. tranylcypromine)
Acetaminophen
Angiotensin-converting enzyme (ACE) inhibitors (e.g. ramipril)
Non- cardioselective beta-blockers* (e.g. metoprolol)
Sulfonylureas** (e.g. glyburide)
Insulin

** Cardioselective β-blockers such as propanolol are less likely to cause problems than non-cardioselective agents.*
***Combinations of blood glucose lowering medications can also increase the risk of hypoglycemia. For example, metformin and acarbose may enhance the hypoglycemic effects of other agents (e.g. sulfonylureas, insulin).*

Ketones spill over into the urine and can be detected using special testing strips available at the pharmacy. These ketones can lead to diabetic coma and death, if not treated. DKA usually only occurs in people with type 1 diabetes and is associated with diabetes management or occurs as a complication due to other illness. If high blood sugar is accompanied by symptoms of nausea and vomiting, abdominal pain, shortness of breath, a fruity odour to the breath or ketones in the urine, patients need to seek medical attention immediately.

Treatment

Hyperglycemia and diabetes are managed by education, lifestyle interventions and drug therapy. Patients will learn how to lower blood glucose levels by healthy eating, physical activity, maintaining a healthy weight, reducing stress, controlling blood pressure and cholesterol, and taking prescribed blood glucose-lowering medications. Physicians, dieticians, diabetes educators, nurses, pharmacists and technicians all become part of the healthcare team that help patients manage their diabetes.

Hypoglycemia

Hypoglycemia is a condition in which blood glucose levels drop too low (generally <4.0 mmol/L). Hypoglycemia can be very severe and lead to confusion, loss of consciousness, coma, seizure and even death. The cut-off for when blood glucose is considered too low, is generally accepted as less than 4.0 mmol/L; however, some patients may experience symptoms of hypoglycemia at levels above this cut-off of 4.0 mmol/L. These patients must keep their targets above the level at which they experience symptoms but below the level of hyperglycemia-a challenging task.

Risk Factors

Many factors can place a patient at risk of hypoglycemia including aging, impaired kidney or liver function, gastrointestinal disease and medications. For patients with diabetes, lifestyle factors that increase their risk are mainly alcohol consumption, excessive physical activity and missed meals. Some of the medications that patients take to lower their blood glucose can also place them at risk, especially the "sulfonylurea" group (e.g. glyburide).

Symptoms

Symptoms may include:
- inexplicable fatigue;
- increased sweating;
- trembling;
- increased anxiety;
- dizziness;
- drowsiness;
- irritability;
- confusion;
- difficulty speaking;
- blurry vision; and
- excessive hunger.

Treatment

It is critical for patients to be able to recognize and treat all episodes of hypoglycemia promptly. If a patient experiences any symptoms of hypoglycemia and/or has a blood glucose level of less than 4.0 mmol/L, they must immediately ingest 15 g of carbohydrates to provide a rapid increase in blood glucose (an increase of 2.1 mmol/L within 20 minutes[2]).

The following sources provide 15 g of carbohydrates:
- 3 glucose tablets (5 g/tablet, sold at the pharmacy)
- 15 mL (3 teaspoons) or 3 packets of table sugar dissolved in water
- 175 mL (3/4 cup) juice or regular soft drink
- 6 Lifesavers® (1 = 2.5 g of carbohydrates)
- 15 mL (1 tablespoon) of honey or corn syrup
- 3 tablespoons of raisins

Note that milk, orange juice and glucose gels increase blood glucose levels more slowly and are not first choices unless the above alternatives are not available. A valuable tool that the pharmacy team can teach patients to help them remember how to treat a low blood sugar is the "15-15-15 rule." Ingest 15 g of carbohydrates, test in 15 minutes and if the blood glucose level is still below 4.0 mmol/L, ingest another 15 g. Repeat this procedure every 15 minutes, if needed, until the level is above 4.0 mmol/L. To prevent another episode of hypoglycemia, patients should be instructed to have the usual meal or snack that is due at that time of the day. If the meal is more than one hour away, a snack consisting of both protein and carbohydrates (e.g. cheese and crackers) should be eaten.

For severe hypoglycemia where a patient is unconscious, caregivers should be instructed on how to give a glucagon injection intramuscularly or subcutaneously. Glucagon is a hormone that raises the level of glucose in the blood. Adults and chil-

dren older than 5 years of age are given 1 mg glucagon while children under 5 years of age are given 0.5 mg glucagon.

Hyper- versus hypoglycemia

Distinguishing between hyper- and hypoglycemia can be challenging, as there is a large overlap in symptoms (e.g. sweating, trembling, hunger, dizziness, irritability, confusion, blurred vision). Since the treatment is opposite for each condition, it is critical to test the blood sugar when symptoms occur. As well, looking at risk factors that may have led to the condition also aids the patient in knowing which condition they may be experiencing. For example, a skipped meal, an increase in the dosage of blood glucose lowering medication, intense physical exercise or alcohol consumption hints that the patient may be experiencing hypoglycemia. In contrast, eating a very large meal and forgetting an insulin or medication dose suggests hyperglycemia. Only when patients confirm which condition they're experiencing, can they effectively normalize blood sugar and minimize their risk.

The technician's role

Patients with diabetes visit the pharmacy often to pick up medications or purchase supplies for blood glucose monitors and/or insulin injections. The technician is often the patient's first point of contact with the pharmacy care team. Therefore technicians can assist in identifying patients who need further assistance in managing their diabetes and refer them to the pharmacist. If a patient comments, for example, that he/she has been feeling any of the symptoms of hyper- or hypoglycemia as discussed above, the patient should be referred to the pharmacist. As well, patients who inquire about purchasing glucose tablets will require education by the pharmacist regarding how to recognize and treat a low blood sugar. Technicians can also identify patients with diabetes who are not testing their blood glucose at home and can recommend using a blood glucose monitor. In pharmacies where they have been trained, the technician may demonstrate the use of the monitor to the patient.

Patients with diabetes who are choosing an over-the-counter product should also be referred to the pharmacist to ensure that the desired product does not affect their medications or diabetes control. For example, many cough syrups contain sugar and can elevate blood glucose readings. As well, many patients with diabetes also have high blood pressure and should avoid the use of oral decongestants.

By understanding the difference between hyper- and hypoglycemia, the technician can more appropriately refer patients to the pharmacist and help patients along the path to better blood glucose control.

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QUESTIONS

Please select the BEST ANSWER for each multiple choice question.

1. The most common type of diabetes is:
a. Gestational diabetes
b. Type 1 diabetes
c. Type 2 diabetes
d. None of the above

2. Type 2 diabetes can be caused by
a. A decrease in insulin production
b. No insulin production at all
c. Inefficient use of insulin
d. Both a and c

3. Uncontrolled diabetes can lead to which of the following long-term complications:
a. Nerve damage
b. Heart disease
c. Kidney disease
d. All of the above

4. The recommended target blood glucose range for most patients with diabetes testing at home in a fasting state is:
a. 5.0 - 8.0 mmol/L
b. 5.0 - 10.0 mmol/L
c. 4.0 - 7.0 mmol/L
d. None of the above

5. Which of the following is a treatment for hyperglycemia?
a. Attaining a healthy weight
b. Glucose-lowering medications
c. Diabetes education
d. All of the above

6. Risk factors for Type 2 diabetes include all EXCEPT the following:
a. Parent or sibling with diabetes
b. Eating foods high in glucose
c. High blood pressure
d. Age greater than 40 years

7. Hypoglycemia generally refers to blood sugar less than:
a. 3.0 mmol/L
b. 5.0 mmol/L
c. 4.0 mmol/L
d. 2.0 mmol/L

8. Which of the following is a symptom of hypoglycemia?
a. Fatigue
b. Trembling
c. Dizziness
d. All of the above

9. Which of the following medications can contribute to the risk of hypoglycemia?
a. Metformin
b. Glyburide
c. Hydrochlorothiazide
d. None of the above

10. Which of the following treatments is an acceptable treatment for hypoglycemia?
a. Chocolate bar
b. 3 Glucose tablets
c. 1 Cookie
d. 3/4 cup diet cola

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