

Diabetes

Case #2

There has been a 350-fold increase of type 1 diabetes in the past 50 years in Europe and North America. This autoimmune disease usually strikes children and teens. Thirty-five percent of individuals with type 1 diabetes will die of heart disease by the age of 55. Eighty percent will develop retinopathy within 15 years of diagnosis leading to subsequent blindness. Twenty to forty percent will develop kidney disease before the age of 50. In Case #4 we'll experience symptoms, diagnoses, and treatment of diabetes with six-year-old Ali.

Case Objectives

- 1) Review acid-base balance in your text and the case study to include the following:
 - a. Describe the importance of maintaining a normal acid-base balance in the body.
 - b. Define the two systems (organs) responsible for maintaining acid-base balance.
 - c. List 3 key diagnostic values obtained from an arterial blood gas.
 - d. Describe the effects of ketoacidosis on acid-base balance.

- 2) Review the endocrine functions of the pancreas to include the following:
 - a. Describe the function of the beta cells of the pancreatic islets.
 - b. Describe the function of insulin.

- 3) Define the following medical terms:
 - a. Organomegaly
 - b. Hypoglycemia
 - c. Hyperglycemia
 - d. Insulin
 - e. Hypertension
 - f. hypotension.

- 4) Review diabetes mellitus.
 - a. Define diabetes mellitus. (Explain the difference between Type I and Type II diabetes. Describe the differences in treatment).
 - b. List the symptoms in untreated diabetes mellitus.
 - c. Define the tests used in diagnosing diabetes mellitus.
 - d. Define the possible complications of diabetes mellitus.
 - e. Define diabetic ketoacidosis (DKA). Define the laboratory tests useful in diagnosing DKA.

- 5) Contrast the different symptoms in hypoglycemia and hyperglycemia.
 - a. List conditions under which a diabetic may become hyperglycemic.
 - b. List conditions under which a diabetic may become hypoglycemic.
 - c. Compare possible complications of hyperglycemia and hypoglycemia.

- 6) Review the diagnostic testing in the case.
- List the single laboratory test that is the most useful in diagnosing a patient with diabetes mellitus.
 - Describe the purpose of a chemistry screen.
 - Name the electrolytes. List disease states that may cause each to be abnormal.
 - List 2 chemical tests indicative of kidney function.
 - List the chemistry results that may be abnormal in a patient in DKA. Describe why these tests are abnormal.
 - List the urine laboratory tests that are useful in diagnosing diabetes mellitus.
 - Define the forces that cause blood pressure. Define systolic and diastolic blood pressure. List risks of hypertension.
 - Define critical values measured with an arterial blood gas (ABG) and describe their relevance to a patient in DKA.
- 7) Review the health care professionals involved in this case.
- Describe why the services of a dietician are important to a diabetic patient.
 - Summarize the diagnostic tests that would help a pediatrician diagnose a patient with diabetic symptoms.
 - Explain the role of a respiratory therapist in detecting an acid base imbalance.
 - Describe the types of patients an endocrinologist would treat.
 - Describe the role social workers play in a medical setting.
 - List areas in which a clinical nurse specialist may function.
 - Describe ways the health care professionals in this case are dependent upon each other in treating the diabetic patient.



Ali's mother knew there was something not quite right with her daughter lately. She just couldn't put her finger on it. She was trying to explain this over the phone to the nurse at the Pediatrician's office. Ali had been so tired since starting first grade. She had been wetting the bed every night, something that had not occurred since she was two. "I've been trying to cut back her liquids at night," explained Ali's mother, "but she seems to be so thirsty that I finally give in and give her a drink at bedtime. She literally guzzles that down and wants more. I'm not sure what to do." The nurse explained that the next available exam opening was in two weeks. "Could they come then?" Ali's mother uneasily agreed to the date and hung up the phone.

The following day, Ali's family was planning a trip to the local amusement park. "Ali, are you still eating breakfast? Let's go!" "But I'm still hungry," Ali shouted back. "Mom, that's her third bowl of Cheerios and she's gulped about half of that gallon of milk!" Her big brother Mike was getting impatient as well. "It's amazing that someone that skinny can eat that much. Talk about a hollow leg." Ali's mother looked back at her. She really didn't have an ounce of fat on her body. "Oh, to be young," she mused. "I wish I could get away with eating that much!"

At the amusement park, Ali made a beeline for the nearest bathroom after every ride. "She is such a pain!" exclaimed Mike. "I bet she's just doing this to annoy me. We're not going to get to ride on anything." Ali's mother didn't answer. She was genuinely worried. She had accompanied Ali each time to the restroom and she knew Ali was not just trying to be annoying. How could anyone have to go that much?

The next day was Sunday. Ali's mom had just woke up from a well-deserved nap. She had been up three times the night before changing Ali's sheets. She found her daughter lying on the couch watching TV. "Why don't you go outside and play. It's a nice day." "I can't breath very good, and I feel sick to my stomach," replied Ali. Ali's mother looked at her in alarm. Her breathing was very rapid and labored. She looked pale, and so thin. She called and talked with an emergency room nurse at the local hospital. After asking a few questions, the nurse recommended bringing Ali in to be examined.

In the emergency room, a urine sample was collected for [urinalysis](#) and blood was drawn for a stat [Chemistry Screen](#), and [CBC](#). Respiratory therapy drew additional blood from an artery for [arterial blood gasses](#).

[Blood pressure](#) was 145/70 mmHg, heart rate was 120 beats per minute, respiration rate was 36 per minute, and oral temperature was 98.4°F. Chest sounds were clear and abdomen was soft with no [Organomegaly](#).

- 1) *List 3 functions of the kidneys as discussed in the "urinalysis" site.*
- 2) *What are some substances detected by a urinalysis?*
- 3) *What 2 methods are used when performing a urinalysis?*
- 4) *What is a chemistry screen?*
- 5) *What blood chemistry test is a diagnostic indicator for diabetes?*
- 6) *Name the electrolytes. What disease states may cause each to be abnormal?*
- 7) *What 2 chemical tests are indicative of kidney function?*
- 8) *Which health professional would perform urinalysis and chemical tests on the blood?*
- 9) *What do arterial blood gasses (ABG's) test for?*
- 10) *Why would a physician order an ABG?*
- 11) *What type of blood is used for ABG's? Why?*
- 12) *Which health professional would perform arterial blood gas measurements?*
- 13) *What do the systolic and diastolic blood pressure readings reflect?*
- 14) *Untreated high blood pressure may lead to what disease states?*

The arterial blood gas results were the first to come back.

[Arterial Blood Gas Results](#)

Laboratory Results

The laboratory results were consistent with [Diabetic ketoacidosis \(DKA\)](#) as a result of untreated insulin dependent [diabetes mellitus](#) (IDDM). Ali was admitted to the hospital where intravenous fluids were started to alleviate dehydration. An insulin I.V. drip was also started.

- 15) *Why do untreated type I diabetics go into a state of ketoacidosis?*
- 16) *What are common symptoms of DKA?*
- 17) *What is the most common cause of diabetes in children?*
- 18) *How does insulin affect glucose in the body?*
- 19) *What are the classic symptoms of diabetes?*
- 20) *What is the cause of each symptom?*
- 21) *How is diabetes diagnosed?*

The following morning Ali and her parents met with a diabetes nurse educator. She explained that insulin is like a key that unlocks the door to the cells in the body so that glucose can pass through. Ali's body had destroyed the beta cells in her pancreas that make insulin, so her body had not been getting any nutrients. High glucose levels in the blood and the kidneys caused excessive fluid loss causing Ali's severe dehydration. From now on, Ali would have to give insulin by shots. Ali practiced giving shots to oranges, and even practiced on mom and dad. She also practiced testing her blood sugar on a glucometer.

- 22) *In what ways is a nurse educator different than a traditional registered nurse?*

Ali's next visitor was the endocrinologist. He explained that they would be testing her blood sugar every two hours for the next day. This would help him decide how much insulin she would need when she left the hospital. Ali would be taking two insulin shots a day, before breakfast and dinner.

- 23) *What type of patient would an endocrinologist treat?*

A meeting with the dietician was next. Insulin is given based upon the amount of food that will be eaten throughout the day. Ali would need to stick to a special diet to keep her blood sugars in control. Eating too much would elevate her blood sugars (hyperglycemia) and not eating enough could lower her blood sugars ([hypoglycemia](#)) and cause her to have an insulin reaction. Ali and her parents set up a meal plan with the dietician based upon the amount of food Ali would normally eat in a day.

- 1) *How can a Type I diabetic become hypoglycemic?*
- 2) *List symptoms that may accompany hypoglycemia.*

The last meeting of the day was with a medical social worker. She gave Ali tips on how to fit in at school with her diabetes, how to educate her teacher, and how to deal with the upcoming Halloween, Thanksgiving, and Christmas holidays, where there is a lot of extra food and sweets.

Three days after being admitted to the hospital Ali went home with a brand new lifestyle. She was soon testing her own blood and even giving her own shots. She regained her energy and soon began to put on some much needed weight. When her friend's older brother expressed amazement

the she would give herself a shot she responded, "It's not that hard. And besides, it makes me feel so much better it's worth it!"

Case Summary

- 1) Insulin-Dependent Diabetes Mellitus (IDDM), also categorized as Type I diabetes, is an autoimmune disease of children in which the body's immune system attacks the insulin producing beta cells on the pancreas. It is theorized that this immune response may be triggered during a viral infection in those with a genetic predisposition to the disease.
- 2) The symptoms of undiagnosed diabetes include excessive hunger and thirst, weight loss, frequent urination, and fatigue.
- 3) The diagnoses of diabetes in this case was made by the endocrinologist based upon elevated levels of glucose in the blood and urine. Ali was not seen until her disease had progressed to diabetic ketoacidosis. DKA was diagnosed based on the arterial blood gas results showing a pH of less than 7.3, large amounts of ketones in the urine, elevated potassium, and physical symptoms such as rapid heart rate and rapid breathing.
- 4) The goal of treatment of Type I diabetes is to regulate the patient's blood glucose so that it does not rise too high (hyperglycemia) or drop too low (hypoglycemia). This is done by insulin injections, a controlled diet, and exercise. [Insulin pumps](#) function much more like a normal pancreas and are being used increasingly more. Because of the complexity of operating insulin pumps, they are generally not recommended until the teenage years.
- 5) There is no cure for Type I Diabetes Mellitus, except for a pancreas transplant. Because of the highly volatile nature of the pancreas, a transplant is generally done as a last resort. Studies have now proven that diabetics who remain in tight control may prevent or slow the start of diabetic complications.
- 6) There is no known prevention of Type I diabetes. Animal research and small studies in people have indicated that type 1 diabetes can be delayed in those at high risk for the disease by regular, small doses of insulin. This is currently under study.
- 7) Healthcare workers depend on each other in treating a diabetic patient. Laboratory personnel report critical laboratory values including blood chemistry, CBC, and urinalysis results. The respiratory therapist monitors arterial blood gasses in the diabetic patient in DKA. Diabetic educator nurses have a responsibility to not only show the patient how to give injections, but to educate the diabetic about all aspects of their disease. It should be noted that in many cases staff nurses may work to educate patients about diabetes. The diabetics overall control relies heavily on their diet. The dietician plays a key role in developing a meal plan and educating the patient about the importance of diet. Social changes and adjustments by the patient and family are facilitated by the medical social worker. The endocrinologist has the ultimate responsibility for the diabetics health. He prescribes insulin based on the patient's diet and lifestyle. He must be ready to make key decisions for the day to day health of the diabetic as well as for life threatening complications.

Answers to Case Questions

Question 1

- a) Filter blood to remove waste products and help maintain substances necessary to the blood.
- b) Help control blood pressure.
- c) Synthesize vitamin D

Question 2

- a) Cells including RBC's and WBC's.
- b) Bacteria.
- c) Chemicals including glucose.
- d) pH concentration

Question 3

- a) Urine dipstick.
- b) Microscopic exam

Question 4

A blood test that measures chemicals in the blood.

Question 5

Blood glucose.

Question 6

- a) Sodium - Dehydration, heart or kidney abnormalities.
- b) Potassium - Vomiting or diarrhea. Increased in kidney failure.
- c) Chloride - Abnormal changes occur with changes in sodium level.
- d) Bicarbonate - Changes with problems in acid/base balance.

Question 7

Blood Urea Nitrogen (BUN), Creatinine.

Question 8

Clinical Laboratory Scientist

Question 9

pH (acidity), oxygen content, and carbon dioxide content of the blood.

Question 10

A physician orders an ABG to detect changes in the patient's acid-base balance in the blood. This balance is critical. The lungs and the kidneys regulate acid-base balance. An ABG can therefore detect respiratory conditions or disease, kidney function (metabolic), and is also used to monitor oxygen therapy.

Question 11

- a) Arterial.
- b) Arterial blood is oxygenated blood.

Question 12

Respiratory therapist.

Question 13

- a) Systolic: Force on blood vessels from the pumping of the heart.
- b) Diastolic: Lowest pressure on the blood vessels when the heart is relaxed.

Question 14

Heart disease, kidney disease, stroke.

Question 15

Type I diabetics do not produce insulin. Insulin is necessary to carry glucose into the cells where it is utilized. When the cells do not receive energy from carbohydrate breakdown, the body begins to break down fat as a secondary energy source. Byproducts of fat breakdown are ketone bodies which lead to the blood being more acidic than the tissue.

Question 16

Symptoms include frequent urination and thirst, weight loss, increased appetite, fatigue, nausea, vomiting, muscle stiffness, mental stupor, hyperventilation, fruity breath.

Question 17

Destruction of the insulin producing beta cells of the pancreas by the body's own immune system.

Question 18

Insulin is released as the body's blood glucose (sugar) begins to rise. The insulin facilitates the transport of the blood glucose into the cells.

Question 19

Excessive thirst, frequent urination, weight loss.

Question 20

The body's cells are starving because they cannot get the glucose they need for energy. Glucose levels rise in the bloodstream because it is not transported into the cells. The kidneys flush extra water out, trying to get rid of the excess glucose. This causes dehydration, excessive urination, and excessive thirst. Because the cells cannot get the energy they need, the body breaks down fat stores for energy and weight loss occurs.

Question 21

Increased glucose levels in the blood and urine. Ketone bodies are present in the urine in cases of diabetes ketoacidosis.

Question 22

A nurse educator specializes in nursing education. Typically a nurse educator has a masters or doctorate degree.

Question 23

An endocrinologist is a specially trained physician who treats patients with diseases that affect hormone-producing glands.

Question 24

Giving too much insulin for the amount of food eaten.

Question 25

Symptoms vary from individual to individual but may include anxiety, sweating, tremor, palpitations, nausea, and pallor headache, mild confusion, and abnormal behavior. Severe hypoglycemia may lead to seizure, unconsciousness, and coma.

Health Professionals Introduced in this Case

[Endocrinologist](#)

[Social Worker](#)

[Physician](#)

[Nursing](#)

[Pediatrician](#)

[Nurse Educator](#)

[Dietician](#)

[Clinical Laboratory Scientist](#)

[Respiratory Therapist](#)

Additional links of Interest

[Acid-Base Tutorial](#)

[Diabetes Mellitus](#)