Case Study: Diabetes Type 1
Case Study # 1

Background Information: Type I Diabetes or Insulin-Dependent Diabetes Mellitus (IDDM). Results from a deficiency of insulin usually due to the person’s immune system (autoimmune disorder) destroying the pancreatic cells (beta cells) that produce insulin. The diagnosis of Type 1 diabetes involves testing the urine and blood. The urine will be tested for the presence of glucose and ketone bodies. Blood will be tested for glucose levels, hemoglobin A1c (HbA1c) and C-Peptide. See class notes for more information on the tests. The following information will provide the basis for the C-Peptide Test: Insulin is synthesized in the beta cells of the pancreas. Insulin is initially synthesized in the form of proinsulin which consists of three chains of peptides, A, B, and C. Further modification by the Golgi apparatus cleaves portions of the molecule to form insulin, composed of the A and B chain connected by disulfide linkages, and the C chain peptide, called connecting peptide (C-peptide). The secretory vesicle then releases insulin and C-Peptide into the blood. The C-peptide test measures the level of this peptide in the blood. It is generally found in amounts equal to insulin because insulin and C-peptide are linked when first made by the pancreas. Insulin helps the body use and control the amount of sugar (glucose) in the blood. Insulin allows glucose to enter body cells where it is used for energy. The level of C-peptide in the blood can show how much insulin is being made by the pancreas. C-peptide does not affect the blood sugar level in the body. A C-peptide test can be done when diabetes has just been found and it is not clear whether type 1 diabetes or type 2 diabetes is present. A person whose pancreas is deficient in insulin production (type 1 diabetes) will have a low level of blood insulin and C-peptide. A person with type 2 diabetes can have a normal or high level of C-peptide.

History: Cindy Mallon, an 8-year-old girl in previously good health, has noticed that, in the past month, she is increasingly thirsty. She gets up several times a night to urinate, and finds herself gulping down large amounts of water. At the dinner table, she seems to be eating twice as much as she used to, yet she has lost 5 pounds in the past month. In the past three days, she has become nauseated, vomiting on three occasions, prompting a visit to her pediatrician.

Lab Work: At the doctor’s office, blood and urine samples are taken showing the following lab results:

- Fasting blood glucose level = 445 mg/dl (normal = 70 - 100 mg/dl)
- blood pH level = 7.23 (normal = 7.35 - 7.45)
- Hb A1C = 9.5% (normal = 4 - 5.6%)
- C-Peptide Test = 0.4 ng/ml (normal = 1.0 - 4.3 ng/ml)
- urine = tested positive for glucose and for acetone / acetoacetate / beta-hydroxybutyric acid (i.e. ketone bodies) (normally urine is free of glucose and ketone bodies)
A. Based on the above lab results you determine that Cindy has diabetes. What specific type does she have and what test(s) support your conclusion?

B. Explain why her blood-glucose level is elevated?

C. Why is her blood pH level decreased?
D. Cindy’s blood test is found to have a glycosylated hemoglobin level (Hb A1C) of 9.5%. What is the basis for this test? What additional information does this test provide that a one-time direct measurement of blood glucose doesn’t? What is the normal range for glycosylated hemoglobin?

E. At the office, Cindy is breathing rapidly and taking deep breaths. What physiological purpose does this serve?
F. Cindy has a fruity odor to her breath. Explain why.

G. Explain why Cindy is urinating so frequently.

H. How is Cindy's condition like that of starvation? Address the role of glucagon in your answer.