

Problem Based Exercise- diabetes

Group Members

Please place an asterisk next to the recorder's name. Only write the names of the students who are present. The grade for this exercise is based on participation and the answers given.

INSTRUCTIONS: This exercise depends on each and every member participating and no one person dominating the group. The questions from part 1 will be discussed as a group. The questions from part 2 will be slightly different for most groups. Each group will be responsible for reporting at least one point to the rest of the class.

PART 1: A 31-year-old, stockily built male has arrived at the emergency room of Scripps Hospital. He has been admitted semiconscious and had complained that he was generally tired, thirsty and urinates excessively (no he's not pregnant). His breath was fruity smelling. He has moderate to severe dehydration. A urine sample was 1 gm/dl (normal vales 0.5-1.5 gm/24 hrs) and was positive for ketones. An arterial blood sample was taken. The patient was immediately given 100 units of insulin and an intravenous drip of sodium bicarbonate was started (50 ml of 44 mM). The patient had been a football player and is in generally excellent health. His family history is unremarkable except for heart disease. He does not smoke, drink nor use drugs. He is not nor has he been on any chronic medication. Nor does he have any allergies. His weight has increased gradually over the last few years although he has experienced a weight loss the last few weeks.

1) Answer the following questions on a separate page of paper. As a group we will discuss each of the following.

- a) What are type I and type II diabetes and what are the potential causes
- b) What is the insulin for and what will it do? (be specific not general)
- c) Why is the blood pH low?
- d) What is sodium bicarbonate and what is the purpose of the bicarbonate.?
- e) What would happen if either type of diabetes were to go uncontrolled? Describe both: biochemically (major focus) and clinically.
- f) What is an ion gap and does it have an impact on diabetes?
- g) What are the normal and potential patient values for ketones for our patient? Why do we care about ketones? What does ketone or glucose in urine spillover indicate metabolically?

The blood tests results were:

	Patient	Normal Values
Blood Glucose	1008 mg/dl	70 -110 mg/dl
Creatine	3.2 mg/dl	0.6 - 1.2 mg/dl
Na ⁺	131 meq/dl	136 - 142 meq/dl
K ⁺	5.2 meq/dl	3.8 - 5.0 meq/dl
HCO ₃ ⁻	13.5 meq/dl	22 - 26 meq/dl
pCO ₂	18 mm Hg	34 - 45 mm Hg
pO ₂	95 mm Hg	80 - 100 mm Hg
Blood pH	7.05	7.35 - 7.45

For all students to consider:

- a) Are there other blood parameters we are missing (ion gap?)
- b) Which readings are out of range and what might be the underlying cause?
- c) Now what treatment should be given to the patient?

Part 2 case I

Give 100 units more insulin and additional sodium bicarbonate -
Now the blood sugar is 150 mg/dl and the pH is 7.1.

- a) Why did the patient respond this way?
- b) What is happening and why did it happen?
- c) Why did he lose weight without trying?
- d) Why did severe hyperglycemia develop in this patient?
- e) How can monitoring the hemoglobin be an important tool in monitoring a diabetic?
- f) What is the actual reaction that takes place when the blood glucose levels are high?

You've given an additional 200 units of insulin and sodium bicarbonate -
The blood glucose level has not changed but the pH is now 7.1.

- a) Why did you give the original 100 units of insulin and what were the immediate effects?
- b) Why did the pH change but not the glucose level?
- c) How does insulin act on the protein/genetic level?
- d) What is a brittle diabetic? How does one become brittle?
- e) What are some of the chronic problems associated (and possible causes) associated with diabetes?

Diabetes Problem based learning

Part 2 case III

You've administered 400 units of insulin and now the blood glucose is down to 50 mg/dl.
What did you do! Can you say malpractice?

- a) Why did the blood glucose drop down so low?
- b) Where did the glucose go and what are you going to do?
- c) What is hypoglycemia and why is it a problem in diabetes?
- d) Clinically, what happens when the blood sugar gets too low?
- e) What biochemical pathways are being effected? How. What about glucose transport?
- f) How does obesity increase the risk of diabetes?

Diabetes Problem based learning
Part 2 case IV

Give 100 units more insulin and additional sodium bicarbonate -
Now the blood sugar is 150 mg/dl and the pH is 7.1.

- a) Why did this happen?
- b) What are the differences between type one and type two diabetes?

A few weeks after the patient has fully recovered, (wow! You must be good!) You want to administer a glucose tolerance test. Basically a bolus of glucose is given to the patient and the blood glucose is monitored over time.

- c) Draw the blood glucose levels during a glucose tolerance test for a normal person, a type one and type two diabetic.
- d) On separate graph show the insulin and glucagon levels for each person during the glucose tolerance test
- e) If your patient is diabetic how is this test likely to be different than a normal person? Describe this as the concentration of blood glucose over time.
- f) Often times a woman in mid to late term pregnancy is given an oral glucose tolerance test. Why? What is type of diabetes is being tested?

Diabetes Problem based learning
Part 2 case V

You believe that it is best to leave the patient alone and let "nature" take it's course (you must have done well in med school and NOT listened to your biochemistry teacher at college).
Now the blood sugar is 900 mg/dl and the pH is 6.8.

- a) What happens to the patient if you don't give additional treatment?
- b) What does it mean that glucose is found in the urine?
- c) Imagine before insulin was isolated, what do you suppose would happen to a person with this disease with only nutritional treatments? The answer isn't simply just go into a coma and die.
- d) Two hallmarks of diabetic patients are cataracts and neuropathy. Why does this happen?
- e) Why is it common for elderly patients to develop diabetes?
- f) Describe the nutritional changes that one of these patients might need to make. Be certain to explain your reasoning behind your ideas.