MECHANISMS OF HUMAN DISEASE
AND
PHARMACOLOGY & THERAPEUTICS

CASE-BASED SMALL GROUP DISCUSSION

MHD II
Session VIII

Friday, March 27, 2015

STUDENT COPY

Required reading: ACP Medicine (Scientific Medicine)
Online: Endocrinology & Metabolism
Type 1 Diabetes Mellitus - Diabetic Emergencies in Type 1 Diabetes Mellitus

Recommended Reading: ACP Medicine (Scientific Medicine) Online: Endocrinology & Metabolism
CASE 1

History
A 19 year-old marine was brought to the infirmary after passing out during basic training. He had repeatedly complained of severe weakness, dizziness, and sleepiness during the preceding 4 weeks of boot camp. In a previous episode 3 weeks earlier, he had drowsiness and generalized tiredness, and was brought to the infirmary, where after IV administration of saline, he was returned to duty with the diagnosis of dehydration. No laboratory testing was performed at that time. Upon questioning, he reported unquenchable thirst, and the repeated need to urinate. Although he ate all of his rations, as well as whatever he could get from his fellow trainees, he had lost 19 pounds over the prior 2-3 months. (Baseline body weight was 150 pounds, height 5'8" – BMI 23.). On the day before admission, he complained of vague abdominal pain, which worsened by the morning of admission. He had one episode of vomiting green-mucous like material.

Physical Examination
He was oriented. He appeared pale. His respiratory rate was 36/minute. His breath smelled sickly sweet. Supine his heart rate was 138/minute and regular, and his blood pressure was 90/60. Upon standing he felt dizzy and needed to lie back down. Skin turgor was poor. His oral mucous membranes were dry. His lungs were clear to auscultation bilaterally and normal to percussion. On heart exam normal S1 and S2 were auscultated. The rate was tachycardic. There were no murmurs, rubs, or gallops heard. The PMI was in the 5th intercostal space, midclavicular line. There was an ill-defined generalized abdominal tenderness, which was otherwise soft to palpation and showed no rebound. Bowel sounds were normal.

Admission Laboratory Evaluation

<table>
<thead>
<tr>
<th>Basic Metabolic Panel</th>
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<tbody>
<tr>
<td>Glucose</td>
<td>560</td>
<td>[70 - 100]</td>
</tr>
<tr>
<td>Blood Urea Nitrogen</td>
<td>38</td>
<td>[7 - 22]</td>
</tr>
<tr>
<td>Creatinine</td>
<td>1.9</td>
<td>[0.7 - 1.4]</td>
</tr>
<tr>
<td>Calcium</td>
<td>8.9</td>
<td>[8.5 - 10.5]</td>
</tr>
<tr>
<td>Sodium</td>
<td>136</td>
<td>[136 - 146]</td>
</tr>
<tr>
<td>Potassium</td>
<td>5.4</td>
<td>[3.5 - 5.3]</td>
</tr>
<tr>
<td>Chloride</td>
<td>101</td>
<td>[98 - 108]</td>
</tr>
<tr>
<td>Carbon Dioxide</td>
<td>10</td>
<td>[20 - 32]</td>
</tr>
</tbody>
</table>

| Ketone Bodies                     | 320   | [NEG] mg/dl |
| b-Hydroxybutyrate                 | 3.8   | [0.0-0.3] mmol/l |

<table>
<thead>
<tr>
<th>BLD GAS PROF</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>7.26</td>
<td>[7.36-7.46]</td>
</tr>
<tr>
<td>pCO2</td>
<td>21</td>
<td>[32-46] mmhg</td>
</tr>
<tr>
<td>pO2</td>
<td>128</td>
<td>[74-108] mmhg</td>
</tr>
<tr>
<td>HCO3</td>
<td>10</td>
<td>[21-29] mm/l</td>
</tr>
</tbody>
</table>
EDUCATIONAL OBJECTIVES
CASE 1

1. Develop a problem list

2. Interpret the blood gas

3. What is this patient’s diagnosis?

4. Comment on the patient’s abdominal pain and nausea.

Hospital Course
He was treated with insulin and saline I.V. By the 4th hour of treatment, potassium chloride was added IV at a rate of 15 mEq/hour. Sixteen hours later, he was active, alert, well hydrated and indicating he felt much better. He was hoping to be discharged. His physician switched his insulin to subcutaneous injections and started a liquid diet. He was later put on a diabetes maintenance diet and treated with a daily injection of insulin glargine and premeal subcutaneous injections of insulin lispro. Blood for Hemoglobin A1C was drawn prior to discharge and was 11%.

5. Why did the patient improve after being given IV saline in his first visit to the infirmary?
6. Why was he tachypneic during his second evaluation in the infirmary?

7. He was hyperkalemic on admission, and yet, why was potassium later added to the IV infusion?

8. A hemoglobin A1C level of 11% in this patient correlates to approximately what mean plasma glucose level?

9. Discuss the rationale of treating this patient with glargine and lispro insulin’s.

10. This marine tells the infirmary physician that he has a friend with diabetes and that she seems to be going to the doctor and getting “tests all of the time”. Educate this patient on the recommended frequency and rationale of monitoring the following:

   Blood pressure monitoring
   HBA1C monitoring
   Lipid Profile
   Urine microalbumin
   Comprehensive foot exam
   Dilated Eye Exam
   Influenza vaccine
   Pneumovax
   Diphtheria-tetanus-acellular pertussis (DTaP) booster
CASE 2 - Complete Note from EPIC

CC: “I think I need a good doctor and some blood tests”

History Present Illness:
The patient is a 52 year-old woman who presents requesting to establish care and for blood tests. She has had a 2-week history of polyuria, polydipsia, and polyphagia. Her vision has been intermittently blurred for about the past 2 weeks as well. Her energy level is not quite as good as it used to be. She denies any symptoms of numbness, tingling in her hands or feet, dysuria, chest pain, cough or fevers.

In the office we obtained a random fingerstick glucose of 292mg/dL. She has no prior known history of diabetes and no family history of diabetes.

Past Medical History:
Childhood illnesses:
Patient only reports having had Varicella

Immunizations:
Tetanus shot 6 years ago after stepping on a piece of glass
Received the influenza vaccine this year at a community clinic

Adult illnesses:
Fibrocystic breast changes
Anxiety
Acute bronchitis 12-08

Hospitalizations:
childbirth
appendectomy

Surgeries:
Appendectomy 1972
cesarean section x1
Breast biopsy x 1 in 2000 – told it was a benign cyst

Injuries/Accidents:
Stepped on broken glass during a picnic 6 years ago

Obstetric History:
G3P2012

Transfusions: none

Current Health Status

Medications:
Has a prescription for alprazolam 0.25mg to take three times daily as needed for anxiety – has not needed to take it in over 6 months
Acetaminophen as needed for occasional headache

Allergies: none
Health Screening:
Last mammogram and PAP smear at age 46, both were “normal”

**Diet:** tries to eat “healthy” but not sure she succeeds. Eats out at least 2x/week with husband

**Sleep:** satisfied with sleep

**Exercise:** has membership at gym, goes once/month and walks on treadmill

**Tobacco:** never  
**Alcohol:** wine on special occasions  
**Drugs:** never  
**Alternative medicines/therapies:** none

**Psychosocial History**

**Marital Status:** married  
**Living arrangement:** lives with husband, has a great marriage, has good relationships with her children  
**Employment:** Works as grade school principal

No significant life events. Patient reports being generally happy. Since becoming a principle at a school in a new district her anxiety is much improved

**Family History**

Father died an MI, age 65  
Mother died at age 90, “old age”  
Brother died at age 66 of lung cancer (was a smoker)  
Patient has three healthy siblings

**Review of Systems**

**General:** tired all the time, gained 10 pounds in the last year – attributes to little exercise and eating out too much, no fevers or chills

**Skin:** no irritation or abnormalities

**Head:** occasional tension headache, getting less often with new job

**Ears:** no problems

**Nose/Sinuses:** no problems

**Mouth and Throat:** no problems, has fallen behind in seeing a dentist

**Breasts:** lots of lumps, much less tender since periods stopped

**Respiratory:** no cough or shortness of breath

**Cardiac:** no chest pain, palpitations, shortness of breath

**Gastrointestinal:** normal bowel movements, never any blood

**Genitoreproductive:** menopausal
Musculoskeletal: no pain or stiffness reported
Peripheral Vascular: no cramps or peripheral pain/problems
Psychiatric: much more relaxed, less anxious in new school district; not depressed, no anhedonia
Endocrine: no temperature sensitivity
Hematologic: no easy bruising or bleeding

**PHYSICAL EXAMINATION:**

Nursing vitals reviewed: BP 162/74, pulse 90, resp 16, temp 98.5°C; weight 180#, Height 5’5”
Blood pressure readings obtained by me using a large cuff: Right arm 162/74, left arm 158/74
Patient is alert, oriented, calm. Appears stated age
Eyes: EOMI, eye lids clear, and cornea white
Fundoscopic exam: no microaneurysms, hemorrhages or exudates
Head: Normocephalic, no masses, no lesions
Jugular vein: filled while supine
Ears: External ears normal
Oropharynx: Lips, mucosa, and tongue normal. Posterior pharynx clear
Neck: Neck supple, no adenopathy, no thyromegaly or thyroid nodules
Pulmonary: Chest symmetric, lungs clear bilaterally
Heart: Regular rate and rhythm, +S1S2, no murmurs/rubs/gallops
Peripheral vascular: Bilateral carotid, radial, DP and PT pulses are normal, no carotid bruits
Abdomen + bowel sounds, protuberant, soft, nontender, no masses, no hepatosplenomegaly
Extremities: bilateral heel calluses, otherwise feet unremarkable
Neurologic: no deficits on monofilament testing

**Problem List:**

**Assessment/Plan:**

**EDUCATIONAL OBJECTIVES:**

1. Complete the clinic note by writing the “Problem List” and Assessment and Plan” based on the given data. Present as if you are present to your attending in the clinic.
Fasting Laboratory Data (obtained the day after the clinic visit)

**Basic Metabolic Panel**

<table>
<thead>
<tr>
<th></th>
<th>218 H</th>
<th>[70 - 100] mg/dl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucose</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blood Urea Nitrogen</td>
<td>24</td>
<td>[7 - 22] mg/dl</td>
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<td>Creatinine</td>
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<tr>
<td>Carbon Dioxide</td>
<td>26</td>
<td>[20 - 32] mmol/L</td>
</tr>
</tbody>
</table>

**Lipid Profile**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Cholesterol</td>
<td>266 H</td>
<td>[&lt;200] mg/dl</td>
</tr>
<tr>
<td>Triglyceride</td>
<td>285 H</td>
<td>[&lt;150] mg/dl</td>
</tr>
<tr>
<td>HDL Cholesterol</td>
<td>29 L</td>
<td>[&gt;39] mg/dl</td>
</tr>
<tr>
<td>LDL Cholesterol</td>
<td>191 H</td>
<td>[&lt;100] mg/dl</td>
</tr>
<tr>
<td>Non-HDL Chol (calc)</td>
<td>237H</td>
<td>[&lt;160] mg/dl</td>
</tr>
</tbody>
</table>

Measured LDL Cholesterol 180 H [<100] mg/dl

**HEMOGLOBIN A1C** 9.2 H [4.0-6.0] %

EST AVG GLUCOSE - EAG 217 MG/DL Final

Comment: The reporting of the estimated average glucose (eAG) result which is calculated as ((28.7xHbA1c)-46.7) is presented as recommended by the American Diabetes Association. (Diabetes Care 31:1-6, 2008)

**UA w/Micro**

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<table>
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<tbody>
<tr>
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<tr>
<td>Clarity</td>
<td>CLEAR</td>
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</tr>
<tr>
<td>pH</td>
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<td>[4.5-8.0]</td>
</tr>
<tr>
<td>Spec Gravity</td>
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<td>[1.003-1.035]</td>
</tr>
<tr>
<td>Protein</td>
<td>NEG</td>
<td>[NEG]</td>
</tr>
<tr>
<td>Blood</td>
<td>NEG</td>
<td>[NEG]</td>
</tr>
<tr>
<td>Glucose</td>
<td>3+ A</td>
<td>[NEG]</td>
</tr>
<tr>
<td>Ketones</td>
<td>NEG</td>
<td>[NEG]</td>
</tr>
<tr>
<td>Test</td>
<td>Result</td>
<td>Normal Range</td>
</tr>
<tr>
<td>---------------------</td>
<td>---------</td>
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</tr>
<tr>
<td>Bilirubin</td>
<td>NEG</td>
<td>[NEG]</td>
</tr>
<tr>
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<td>[0.2-1.0] eu/dl</td>
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<tr>
<td>NITRATE</td>
<td>NEG</td>
<td>[NEG]</td>
</tr>
<tr>
<td>LEUKOCYTES</td>
<td>NEG</td>
<td>[NEG]</td>
</tr>
<tr>
<td>RBC</td>
<td>0-2</td>
<td>[0-2] /hpf</td>
</tr>
<tr>
<td>WBC</td>
<td>0-2</td>
<td>[0-5] /hpf</td>
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</table>

<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
<th>Normal Range</th>
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</thead>
<tbody>
<tr>
<td>Microalbumin</td>
<td>14.2</td>
<td>[&lt;19] mg/l</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
<th>Normal Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>MICROALBUMIN/CREAT</td>
<td>9</td>
<td>&lt;20 MG/G CREAT</td>
</tr>
<tr>
<td>Volume</td>
<td>RANDOM</td>
<td>ml</td>
</tr>
<tr>
<td>Urine Random</td>
<td>CREATININE, MG/DL</td>
<td>150.0 MG/DL</td>
</tr>
</tbody>
</table>

2. What are the correlations between the patient’s abnormal blood sugar and her other presenting symptoms?

3. The patient asks “Doctor, what can I do to get this blood sugar down and feel better? “What can I eat?” Discuss nonpharmacologic principles in controlling this patient’s blood sugar. (For students’ review, included at the end of the session is an LUMC patient education handout on diabetic diet basics)
4. Of the oral hypoglycemic agents available, which would you recommend as initial monotherapy in this patient?
5. Discuss mechanism(s) of action and potential side/adverse effects of this drug.

6. The patient states “I hope I never need the insulin shots”. How would you respond?

7. Calculate her approximate daily caloric needs. The patient is a school principal and her daily exercise is generally walking ~3 blocks a day to and from the school parking lot and around the school.

8. Identify the cardiovascular and microvascular risk factors in the history, physical examination, and laboratory data in this patient.
9. Discuss glucose, cholesterol, and blood pressure management objectives for this patient.

10. The fingerstick glucose obtained during the office visit is an example of “point of care” testing. Define point of care testing. (a helpful resource to review is the “Introduction to Laboratory Testing – Introduction to Laboratory Testing” modules on the MHD LUMEN website).

11. The goal Hgb A1c is not achieved with monotherapy as well as lifestyle modifications. The patient remains resistant to starting insulin. The patient’s insurance will require a higher out-pocket expense for more costly agents, and the patient wishes to avoid increased cost. Which class of agents would you add? Discuss mechanism(s) of action and potential side/adverse effects of this group of drugs.

Case 3,4 – Unknowns – Students will not have case data until the session meets
Diet Principles for People with Diabetes

What are carbohydrates?
1. Carbohydrate foods (“carbs”) give your body energy as well as important nutrients, vitamins, and minerals
2. Although carbohydrate-containing foods raise your blood sugar, your body still needs them to function properly. Portion control is the key.
3. Foods with carbohydrate include:
   o Grains, beans, and starchy vegetables
   o Fruits (including dried fruits), fruit juice
   o Milk, yogurt
   o Sweets, desserts
4. Foods with little carbohydrate include:
   o Non-starchy vegetables
   o Meat, poultry, fish, eggs, cheese, and meat substitutes
   o Fats

Meal Times and Snacks
Eat meals and snacks at regular times. Avoid skipping meals. Do not go longer than 5-6 hours without eating during the day.

Carbohydrate Counting
Eat a consistent amount of carbohydrates at meals and planned snacks from day to day. If you take insulin, you may be able to adjust your insulin to the amount of carbohydrates you eat. The number of carbohydrates needed each day varies from person to person. An average meal has 34 carbohydrate choices (or servings) or 45-60 grams of carbohydrate
Eating Out with Diabetes

Since portion sizes at most restaurants can be too big, you may find it hard to control your blood sugar when you eat out. Here are some tips for portion control:

- Share a meal with a friend
- At dinner, ask for a lunch-size or child’s portion
- When you order, get a to-go container and pack up half of your food as soon as it arrives
- Instead of an entrée, choose an appetizer or soup with a salad

Foods at restaurants also tend to be higher in calories, fat, and salt. Here are some tips to try:

- Avoid all-you-can-eat buffets
- Skip the bread baskets and chips
- Drink coffee, tea, sugar-free soda, water, or nonfat milk with your meal
- If you are ordering an entrée, skip the appetizer
- If you drink alcohol, limit how much you drink
- Have salads without bacon bits, cheese, and croutons
- Choose tomato-based sauces and soups rather than those made with cream. Also, ask for all sauces and dressings on the side
- Choose lean meats such as skinless chicken or fish without any breading
- Choose foods that are grilled, steamed, boiled, baked, or broiled
- Ask the cook to make foods without salt. Dishes may be made with salt-free herbs and spices instead

Traveling with Diabetes

Always plan ahead!

Items to always take with you:

- A letter from your doctor that explains how your diabetes is treated
- Medications and insulin, if you use them (If you are traveling by plane, you may need to check with the airline what the current rules about what you can carry on the plane)
- Prescriptions for your medications and insulin
- Your health insurance card
- Emergency contact numbers
- Supplies to check your blood glucose
- Your medical ID bracelet
- Small snacks or glucose tablets that you can take if your blood glucose drops too low
- Always carry extra food or juice with you when you sightsee or walk more than usual. The extra activity may cause your blood glucose to drop too low

Signs and Symptoms

Low Blood Glucose- or “hypoglycemia” can happen when you are more active than usual, eat less food or skip meals, take too much medication or insulin, or drink alcohol

- You may feel dizzy, hungry, sick to your stomach, nervous, cranky, tired, shaky or weak, sweaty, anxious, tingly in your arms or legs. You may also have a headache, blurry eyesight, a rapid heart rate, or unable to think clearly
- Make sure you are eating enough carbohydrate foods at meals, carrying a snack with you for emergencies, taking your medication correctly, or eating when drinking alcohol (refer to Alcohol and Diabetes section)
- Seek medical attention for emergencies

High Blood Glucose- or “hyperglycemia” can happen when you eat too many carbohydrates, miss your medication, are stressed out, or have an infection or illness
- You may feel increased thirst, headaches, blurry vision, frequent urination, fatigue, difficulty concentrating
- Make sure you are following your meal plan, taking your medication correctly, and communicating with your health care team about new medicines or infections/illnesses you may have
- Seek medical attention for emergencies

This information is intended for distribution to individual patients. It is not intended for general use by the public and should not be used for diagnosing or treating a health problem or disease without consultation of a qualified health care professional.