

## Sub-Internship Curriculum on Glycemic Control 7/15/05

### Training problems

#### 11) Glycemic Control

##### A. Rationale:

Type 2 diabetes is a complicating factor in approximately 20% of hospital admissions. An additional 12% of hospitalized patients may have previously unrecognized diabetes (1). An understanding of diabetes management in the hospital setting is essential for the safe and appropriate delivery of health care to this population, especially since there is a move toward tighter inpatient glycemic control, but it is also known that insulin has been associated with a great frequency of medication errors.

##### B. Prerequisite:

- History taking and physical examination (CDIM/SGIM curriculum clinical core competency #3)
- Test interpretation (CDIM/SGIM curriculum clinical core competency #5)
- Communication and relationships with colleagues (CDIM/SGIM curriculum clinical core competency #4)
- Therapeutic decision making (CDIM/SGIM curriculum clinical core competency #6)
- Diabetes mellitus (CDIM/SGIM curriculum training problem # 14)

##### C. Specific Learning Objectives:

###### 1) *Knowledge. Subinterns should be able to:*

- a) Understand the differences between the following common acute metabolic complications of diabetes:
  - i) Diabetic ketoacidosis
    - Usually presents with the following:
      - (a) Plasma glucose  $>250$  mg/dL
      - (b) Arterial pH  $\leq 7.30$  and serum bicarbonate level  $\leq 15$  mEq/L
      - (c) Positive ketonuria or ketonemia (more than trace levels)
    - ii) Hyperglycemic hyperosmolar syndrome
      - Usually presents with the following:
        - (a) Plasma glucose  $\geq 600$  mg/dL
        - (b) Dehydration with effective serum osmolarity  $\geq 320$  mOsm/kg
        - (c) Absence of significant ketoacidosis (trace ketones, or pH as low as 7.3, or serum bicarbonate as low as 15 mEq/L does not rule out this diagnosis)
        - (d) Altered mental status
    - iii) Uncontrolled diabetes without ketoacidosis nor hyperosmolarity
    - iv) Hypoglycemia
      - Usually presents with blood glucose of 50mg/dL or below, with:
        - (a) adrenergic symptoms – sweating, pallor, tachycardia, palpitations, sensation of hunger
        - (b) neuroglycopenic symptoms – headache, loss of concentration, confusion, somnolence, transient sensory or motor defects, convulsions, coma

- b) Understand the co-morbid conditions that affect diabetic control such as infections,

- renal and hepatic insufficiency, myocardial infarction
- c) Recognize the effects of non-diabetic medications such as steroids and pentamidine on glycemic control
- d) Understand the rationale behind good glycemic control, and to recognize that this is a goal not only for outpatient care but for inpatient as well
- e) Understand the pharmacology and adverse effects of commonly used diabetic medications (insulin, sulfonylureas, metformin, glitinides, alpha-glucosidase inhibitors, and thiazolidinedione agents)
- f) Recognize the different insulin preparations and the differences in their time of onset, peak and duration of action
- g) Understand the rationale for giving insulin to cover basal and nutritional requirements
- h) Understand the indications for discontinuation or initiation of diabetic medications during a hospital admission

2) *Skills. Subinterns should be able to:*

- a) Conduct a history:
  - i) Assess for symptoms of hyperglycemia and hypoglycemia
  - ii) Assess for symptoms of underlying conditions (e.g. infection, myocardial infarction) that may have resulted in hyper- or hypoglycemia
  - iii) Detect medication changes that could have caused a change in glycemic control (e.g. steroids and atypical antipsychotics)
- b) Conduct a physical examination
  - i) Evaluate volume status and hemodynamic stability
  - ii) Recognize Kussmaul respiration and acetone breath
- c) Develop a management plan:
  - i) for patients with acute metabolic complications of diabetes - Includes initial emergent supportive care, diagnostic work-up, and follow-up care
  - ii) for patients with hyperglycemia that is indirectly related to their primary reason for admission - Includes education and discharge planning especially if patients have no previous diagnosis of diabetes and are to be sent home on diabetes medications and home capillary (fingerstick) glucose monitoring
  - iii) for diabetics who are on NPO (nothing per orem) or are taking less calories during admission compared to outpatient caloric intake
  - iv) for patients on tube feedings or total parenteral nutrition and are hyperglycemic
  - v) for patients who require insulin during hospitalization and upon discharge by taking into account basal and nutritional requirements, co-morbidities, and other concomitant diabetes medications
  - vi) for patients in the peri-operative setting
  - vii) for an appropriate diet during hospitalization
  - ix) that includes a multidisciplinary approach (Endocrinology, Nutrition, Diabetes Education, etc) as appropriate

3) *Attitudes and professional behavior. Subinterns should demonstrate:*

- a) Compassion towards the patient diagnosed with diabetes
- b) Recognition of the social, economic and emotional impact of this diagnosis
- c) Recognition of the importance of education, nutrition, and exercise for the self-management of diabetes

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Kohn LT, Corrigan JM, Donaldson MS, Eds.: *To Err Is Human: Building a Safer Health System.* Committee on Quality of Health Care in America, Institute of Medicine. Washington, D.C., National Academy Press, 1999.

American Diabetes Association. Hyperglycemic crises in patients with diabetes mellitus. *Diab Care* 2004; 27 (Suppl 1):S94-102.

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#### Case 1:

The resident calls you to the emergency room to see a patient brought in by her friends. They found her unconscious a few minutes ago and say she has diabetes.

- 1) What 3 acute metabolic complications of diabetes are in your differential diagnoses given just the above information?

Diabetic ketoacidosis  
Hyperglycemic hyperosmolar syndrome  
Hypoglycemia

- 2) What would you like to assess quickly (physical exam and/or lab) in the patient even before you obtain a detailed history?

Vital signs  
Blood glucose

- 3) You then learn from her friends that the patient is 20 years old, has been using insulin, and has been having fever and cough the past 3 days. She is a thin white female and shows deep slow breathing. Her blood glucose is 280mg/dL.

- a) Which of your answers is number 1 is the most likely diagnosis?

Diabetic ketoacidosis

- b) What other labs will you order to confirm the diagnosis?

Arterial blood gas  
Serum bicarbonate  
Serum or urine ketones

- c) What are the two general treatment measures that have to be instituted right away?

Intravenous fluid hydration

## Insulin

- d) Her pH is 7.02. Do you give bicarbonate?

This is controversial, but in general, hydration and insulin treatment alone can reverse the acidosis. For pH < 6.9, bicarbonate has been recommended if initial hydration and insulin do not reverse the acidosis.

### Case 2:

A 55 year old obese male with no history of diabetes came in to the Emergency Room with chest pain and was subsequently diagnosed to have a myocardial infarction. He had complications necessitating intubation and was admitted to the intensive care unit. His random blood glucose was 195 mg/dL and on repeat was 210 mg/dL.

- 1) Should anything be done about his blood glucoses now?

Start intravenous insulin infusion.

- 2) A few days later he was extubated and was transferred to the regular floor. His blood glucoses remained in the 160-180mg/dL range fasting. You tell him you suspect he has underlying diabetes and would like to start a treatment plan for him. You start him on an anti-diabetes pill while hospitalized but want to make sure he is ready for discharge. What information/education on diabetes would he need?

Self-monitoring of blood glucose

Prevention, detection and treatment of hypoglycemia

Education on diet and exercise

### Case 3:

A 63 year old female was brought to the Emergency Room unconscious. Her husband says she has diabetes and hypertension. He has brought in her pill bottles, consisting of amlodipine 10 mg qd and glimepiride (Amaryl) 4 mg qd. You do a pill count and it seems there are fewer pills in the bottle than there should be. She does not have a glucometer at home.

- 1) What would you like to assess quickly (physical exam and/or lab) in the patient even before you obtain a detailed history?

Vital signs

Blood glucose

- 2) Labs show a blood glucose level of 32 mg/dL. What immediate steps will you take?

Establish intravenous line.

Give D50 glucose 50 cc per i.v.

- 3) After the immediate steps above, how else will you address her hypoglycemia and her diabetes?

She would need maintenance intravenous fluids containing dextrose (usually D10). This is generally given until the effect of the sulfonylurea is gone and until the patient is awake and can have p.o. intake. A single I.V. push of D50 will not be sufficient.

The patient and spouse have to be educated on hypoglycemia prevention, detection and treatment. A glucose meter should be prescribed and blood glucose monitoring has to be taught. Consider changing her medication to those that do not usually produce hypoglycemia, such as thiazolidinediones and metformin.

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