INSULIN

FLAME LECTURE: 8

RISH 11.1.18

LEARNING OBJECTIVES

- To understand Insulin use in diabetes
- To describe indications, mechanism of action, and side effects of Insulin
- Prerequisites: None
- See also – for closely related topics
  - FLAMEs on Type 2 DM / Medications for treatment of DM

INDICATIONS FOR INSULIN

- Type 1 Diabetes
- **Type 2 Diabetes**
  - If lifestyle changes and oral therapy are not adequate for glycemic control
    - Can add to oral therapy if A1c remains >8.5%
    - Initial therapy if presenting A1c >9.0%
      - If insulin monotherapy, usually use basal insulin
  - All patient with end stage renal disease
- Gestational diabetes
- Acute hyperkalemia

MECHANISM OF ACTION

- Lowers blood glucose levels by promoting absorption from blood and into storage
  - Storage in liver, skeletal muscle, and adipose tissue
- Carbohydrates:
  - Increases: uptake of glucose into cell, increase glycogenesis and glycolysis
  - Decreases: glycogenolysis and gluconeogenesis
- Lipids:
  - Increases: lipid synthesis
  - Decreases: lipolysis and ketogenesis
- Proteins:
  - Increase: protein synthesis and uptake of amino acids
  - Decreases: proteolysis
- Other:
  - Increase: K uptake, cell growth, secretion of gastric acid

PHARMACOKINETICS

- Rapid-acting insulin: Lispro/Aspart= "meal-time insulin"
  - Onset: 15-30 min
  - Peak: 30 min-1.5 hr
  - Duration: 3-5 hr
- Short-acting insulin: Regular insulin
  - Onset: 30 min-1hr
  - Peak: 2-4 hr
  - Duration: 5-8 hr
- Intermediate-acting insulin: NPH insulin (*usually BID administration*)
  - Onset: 1-2 hr
  - Peak: 4-12 hr
  - Duration 14-24 hr

PHARMACOKINETICS (CONT)

- Long-acting insulin: Glargine/Detemir (*once a day or BID*)
  - Detemir:
    - Onset: 3-4 hr
    - Peak 6-8 hr
    - Duration: 6-23 hr
  - Glargine
    - Onset: 1.5 hr
    - Peak: None
    - Duration: 24 hr
- Mixed insulin = mix of regular and NPH (ex: 70/30) (*BID or TID*)
  - Onset: 15-60 min
  - Duration: 14-24 hr

DOSING

- 0.3-0.6 U/kg/day
  - 50% basal
  - 50% bolus
    - 1/3 breakfast
    - 1/3 lunch
    - 1/3 dinner
  - Ex: Patient weighs 120 kg → 120 x 0.6= 72 U
    - 36 U basal
    - 36 U bolus
      - 12 U at each breakfast, lunch, and dinner
- If initiating basal only: usually 0.2 U/kg w/ of minimum 10 U

MORE TO KNOW ABOUT DOSING

- Insulin Sensitivity: how much 1U of insulin is expected to decrease the blood glucose level
  - When blood glucose above pre-defined goal, short-acting insulin is added to the normal bolus dose or given separately between meals
  - Calculation: 1800/total daily insulin requirement
  - On average, 1U will lower serum glucose by 25 mg/dL
- Correcting for carbohydrates: # of units of insulin needed to cover for # of grams of carbohydrates ingested
  - Calculation: 500/total daily insulin
  - On average, about 1 unit/10 g carb

MORE TO KNOW ABOUT DOSING

- Sliding Scale: checking blood glucose level and dosing insulin based on the value

BLOOD SUGAR (mg/dL)	INSULIN DOSE (Units of rapid or short-acting)
<150	0
150-200	2
201-250	4
251-300	6
301-350	8
351-400	10
401-450	12
>450	14

DOSE TITRATION

- Fasting glucose values used to titrate basal
  - Usually titrate 2-4U every 3-7 days until at goal
- Pre-prandial and post-prandial values used to titrate bolus/meal-time
- Increase/decrease by approx 10% based on home readings
  - Can do this every 3-7 days until at goal
- Titrate based on the following goals
  - Fasting: 90-130
  - Postprandial: <180
  - A1c: <7.0
- Should have patient follow up at least every 3 months for insulin review/management

SIDE EFFECTS

- Hypoglycemia
  - More common in premixed and bolus
- Weight gain
  - More common with large bolus (“meal-time”) regimens
- Lidodystrophy at injection site
- Pain and erythema of injection site
- Hypokalemia
- Allergic reaction (rare)
- Edema (rare)

RESOURCES

- Am Fam Physician. 2011 Jul 15;84(2):183-190.
- Am Fam Physician. 2009 Jan 1;79(1):29-36.
- Am Fam Physician. 2010 May 1;81(9):1130-1135
- Am Fam Physician. 2018 Jan 1;97(1):29-37.