

Diabetes Mellitus

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Diabetes Mellitus

- Definition: too much sugar in blood
- Normal fasting blood sugar is 60 -110
- Insulin produced by Beta cells in Isles of Langerhans in Pancreas
- Insulin promotes glucose transport into cell
- Skeletal muscle and adipose are insulin-dependent tissues
- Brain, liver, blood cells need no insulin

Diabetes Mellitus

- 40 - 50 units of insulin normally produced per day
- Counterregulatory hormones blunt effects of insulin
 - Glucagon
 - Epinephrine
 - Growth hormone
 - Cortisol
 - Somatostatin

Type 1

- Pt's own antibodies kill Beta cells
- Need to be given insulin
- Diagnosed by detecting antibodies
- Genetic predisposition - HLA-DR3 & DR4
 - Human leukocyte antigens controlled by genes on chromosome 6

Type 1

- Insulin is all this patient needs
- High blood sugars lead to
 - Erectile dysfunction
 - Renal failure
 - Blindness
 - Frequent and resistant infections

Type 1

- Onset childhood to early adulthood
- Can be treated with pancreatic cell transplant and immune modulators
- Stem cell research would benefit Type 1

Type 2

- 95% of DM is type 2
- Cells become resistant to insulin, probably in young adulthood
- At first, pancreas makes more and more insulin
- Then pancreas poops out

Type 2 Diabetes

- High circulating insulin for 20 years before diagnosis
 - Cardiovascular disease
- High circulating blood sugar
 - Renal failure
 - Peripheral neuropathy
 - Blindness
 - Frequent and resistant infections

Three Mechanisms in Type 2

- Insulin resistance
 - Fewer insulin receptor sites on cells
 - Receptor site defects
 - Not enough glucose transporters inside cell
- Blunted release of insulin
- Over production of glucose by liver

If the patient is taking oral diabetes meds, he or she has Type 2 Diabetes

Oral Diabetic Meds

- Make pancreas squirt out more insulin, known as beating dead horse
 - Old ones
 - New ones
- Delay absorption of CHO's
- Reduce excessive glucose output and reduce insulin resistance

Stimulate Insulin Production

- Old Ones
 - Sulfonureas
 - Meglitinides

Old Ones

- Sulfonureas
 - Glipizide (Glucotrol)
 - Glyburide (Micronase, Glynase)
 - Glimepride (Amaryl)
- Can cause hypoglycemia
- After a while, most patients need a second medication to control sugar

New Ones

- DPP-4 Inhibitors
- Onglyza, Januvia, Janumet
- Stimulate pancreas to produce more insulin
- Beware hypoglycemia

Delay Absorption of Carbohydrates

- Match available glucose to blunted insulin release
- Acarbose (Precose)
- Miglitol (Glyset)
- Make people too farty

Decrease Insulin Resistance

Metformin (Glucophage)

- First drug used to treat Tpe 2 diabetes
- Even used prophylactically
- Kidney damage with contrast medium
- Lowers pressures in kidney so protects kidney, but can lead to lowered excretion in pts with kidney failure

Decrease Insulin Resistance and Reduce Glycogen Release by Liver

- Thiazolidinediones
 - Pioglitazone (Actos)
 - Rosiglitazone (Avandia)
- Edema and heart failure

Injectable Medications for Type 2 Diabetes

- GLP-1 agonists
- SGLT-2 inhibitors

GLP-1 Agonists

- Byetta, Victoza
- Stimulate pancreas to increase insulin output
- Beware hypoglycemia

SGLT-2 Inhibitors

- Invokana, Jardiance, Farxiga
- Excrete sugar in urine
- Ketoacidosis
- Dehydration
- UTI - sepsis

5 Types of Insulins

- Based on:
 - Onset of action
 - Peak
 - Duration
- May be used by Type 1 and Type 2 diabetics
- The phrase, "insulin-dependent diabetic" doesn't mean much

1. Rapid Acting Insulins

- **Rapid Acting**
 - Humalog
 - Novolog
 - Apidra
- **Onset in 10 - 30 min**
- **Peak 30 min - 3 hrs**
- **Duration 3 - 5 hrs**
- **Taken just before meals**
- **Typically used in addition to long-acting insulin**

Inhaled Insulin

- **Afreeza**
- **Also a rapid-acting insulin**
- **Can't use if COPD, asthma**
- **Type 1 diabetics only**
 - Type 2 diabetics need much more insulin than Type 2 - would use 10 vials a dose
 - Minimum dose is 4 units - too much for many Type 1 diabetics

2. Short Acting Insulin

- **Short Acting**
 - Regular
 - Novolin, Humalin
- **Onset 30 min - 1 hr**
- **Peak 2 - 5 hrs**
- **Duration up to 12 hrs**
- **ONLY insulin that can be given IV**
- **Lasts longer than Rapid Acting**

3. Intermediate Acting Insulins

- Intermediate Acting
 - NPH
 - ALSO named Humalin and Novolin
 - Onset 1.5 - 4 hrs
 - Peak 4 - 12 hrs
 - Duration up to 12 - 24 hrs
 - Good for bedtime

4. Long Acting Insulins

- Long Acting
 - Lantus
 - Levemir
 - Onset 0.8 - 4 hrs
 - No peak
 - Duration 24 hrs
 - One dose a day

5. Pre-Mix

- Bid before meals

Insulin Pumps

- Use rapid or short-acting insulin
- Deliver:
 - Basal rate
 - Manual bolus before meals
 - Correction boluses for high blood sugar

Hypoglycemia

- Blood sugar less than 70
- Seizures at 20
- Get sympathetic system symptoms
 - Sweating
 - Shaky
 - Tachycardia
- People with autonomic neuropathy or who are on beta blockers don't get symptoms
- Treat with IV or oral dextrose

Diabetic Ketoacidosis

- Body is unable to use glucose because it lacks insulin
- Breaks down fat for energy
- Ketones are a byproduct of fat metabolism
- Ketones can be measured in the urine

Precipitating Factors

- Not taking insulin
 - Consider intimate partner abuse or child abuse
- Infection or other stressors
 - Increased cortisol
 - Increased glucose production
 - Increased metabolism, increased need for energy

Diabetic Ketoacidosis

- Very difficult for Type 2 diabetic to become ketotic
- 5% mortality
- 4 components
 - Dehydration
 - Insulin deficiency -> hyperglycemia
 - Hypokalemia
 - Acidosis

Hyperglycemia

- Causes diuresis
- Leads to dehydration
- Dehydration causes abdominal pain, vomiting

Hypokalemia

- Lose K⁺ with diuresis
- At first, K⁺ looks high, because, without insulin, K⁺ shifts out of cells
- When we rehydrate and replace insulin, K⁺ is driven back into cells
- Happens in about 2 hours, so first IV bag won't have K⁺ in it; second one should

Acidosis

- Acidosis corrects itself as we correct volume
- VERY few need Bicarb; maybe nobody does
- If pH > 7.1, just drive
- If CO₂ > 7, just drive
- If give bicarb, give VERY slowly, make sure pt breathing well - has to be able to exhale CO₂

Dehydration

- The FIRST priority in treating DKA is to replenish fluid



Treatment

- NS wide open - most need at least 3 liters
- Insulin IV - everyone mixes it differently
 - Give as bolus as close to site as possible
 - Absorbed by plastic
 - Usual drip 0.1 units/kg/hr (8u/hr for 80 kg pt)
- Potassium in second IV bag

Labs

- Potassium - when were the labs drawn?
 - Before any fluid? Should be normal or high (falsely high)
 - After a couple liters? Should be low
- pH - don't flinch if over 7.1
- CO2 - don't flinch if over 7
- Bicarb - don't flinch if pH over 7.1

Glycosylated Hemoglobin (Hgb A1c)

- Blood sugar over past 120 days
- Hgb attracts glucose
- Glucose sticks to it for life of hgb
- Should be less than 1 - 2% above the lab's normal

Renal Function

- BUN
 - More to assess dehydration
 - Affected by protein intake, fever, catabolic rate
- Creatinine
 - Better for looking at renal function
 - Should be lower than normal in skinny little old ladies - depends on muscle mass
 - Creatinine over 4 is irreversible RF

Renal Function

- Urine dip
 - Positive for protein - permanent renal damage
 - Positive for ketones - Type 1 or waaay bad Type 2 or starving
 - Urine sugar is a poor reflection of serum sugar

Cerebral Edema

- Most serious complication of DKA
- NOT related to fluid intake, rapid correction of hyperglycemia
- Seizures - treat with midazolam
- Consider hyponatremia - treatment is IV NS

Coma

- High sugar doesn't create coma
- Hyperosmolarity can create coma
- $2(\text{Na}) + \text{blood sugar}/18 + \text{BUN}/3.0$
- Over 350 mOsm/k is hyperosmolar
- Hint: sugar has to be over 600 - 800

Hyperosmolar Hyperglycemia Nonketotic Coma

- Old, sick person
- Type 2 diabetics ONLY
- Mortality 50 - 70%
- Gotta be sick enough to not be able to replace fluids lost in diuresis
- Develops over days, weeks
- Serum glucose >600, usually in the thousands

HHNK Treatment

- IV NS
 - Careful - old person, easy to get CHF
 - Can be 12 liters or more
 - K+ replacement
 - May or may not need insulin drip
 - Don't decrease sugar more than 100 mg/dl/hr
 - Once serum osmolality 200-300, switch to D5NS or D5 1/2 NS

Questions?


