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DIABETES MELLITUS TYPE 1

Objectives

- ⦿ Recognize the difference between Type 1 and Type 2 DM
- ⦿ Identify the etiology, epidemiology, pathophysiology, and common clinical manifestations of DM1.
- ⦿ Know the pathophysiology, common presentation, labs, complications and proper treatment of DKA
- ⦿ Be familiar with different types of insulin and the length of action, the need for glucose monitoring, insulin pump therapy, and the symptoms of hypoglycemia.
- ⦿ Know the goals of treatment and ways to improve diabetic outcomes.
- ⦿ Recognize the difference between the dawn phenomenon and the somoygi effect.
- ⦿ Identify the common presentation of atypical diabetes, management, and the role of C-Peptide.

Definitions

- ⦿ Diabetes Mellitus (DM) is characterized by hyperglycemia (high blood sugar) and glycosuria (sugar in the urine).
- ⦿ DM Type 1 –
 - Most common type in the pediatric population
 - Autoimmune destruction of the islet cells of the pancreas.
 - MODY – Mature Onset of Diabetes of Youth
 - Type 1 DM that occurs in adulthood – rare
- ⦿ DM Type 2 –
 - Less common in children.
 - Usually combined with obesity
 - Occurs due to insulin resistance
 - Incidence is on the rise in the pediatric population

Diagnosis of DM

- ⦿ To diagnose DM:
 - Fasting serum glucose greater than 126mg/dl
or
 - 2 hour postprandial serum glucose concentration greater than 200mg/dl on two separate occasions
- ⦿ Glucose Intolerant is diagnosed as:
 - Fasting serum glucose between 110mg/dl and 126mg/dl
 - 2 hour postprandial serum glucose concentration greater than 140mg/dl but less than 200mg/dl
- ⦿ These are most helpful in Type 2. Type 1 most frequently presents in DKA.

Etiology of DM Type 1

- ⦿ Autoimmune process
 - Other autoimmune conditions can be diagnosed before or after DM1 – most common is Hashimotos Thyroiditis.
- ⦿ Antibodies destroy insulin producing beta cells of the pancreas (islet cells)
- ⦿ Environmental Factors (data is inconclusive)
 - Cow's milk feeding before 2 years of age
 - Viral infections (coxsackie B virus, CMV, mumps, rubella)

Epidemiology of DM Type 1

- ⦿ DM1 is the most common pediatric endocrine disorder (1:300 or 1:500 under 18)
- ⦿ Genetic determinants play a role.
 - HLA DR3 have a 4 fold risk of develop DM1
 - HLA DR4 – by itself does not seem to increase risk
 - Both alleles can give a 12 fold risk.
 - 90% of children with DM1 have one or both of the above alleles.

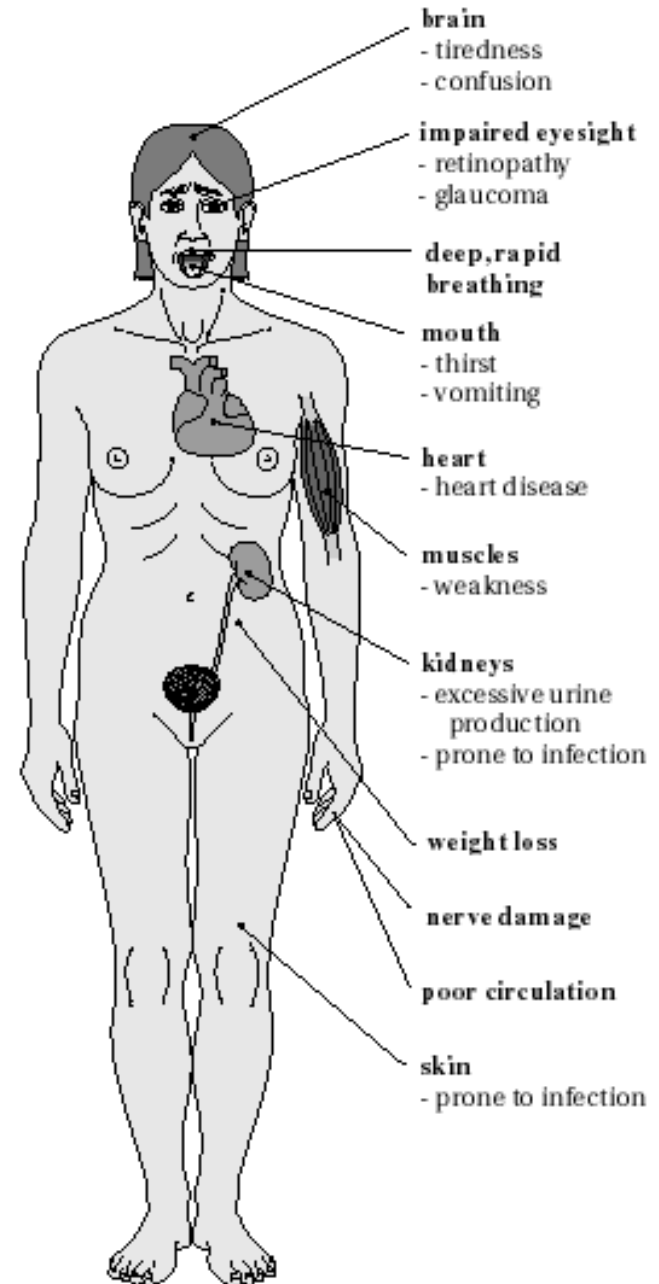
Pathophysiology of DM1

- ⦿ Insulin acts as a key for sugar to enter the cell.
- ⦿ Lack of insulin keeps the sugar in the blood.
- ⦿ The cells are “hungry” so they tell the body to mobilize sugar (gluceneogenesis, glycogenolysis, and fatty acid oxidation)
- ⦿ The sugar is still trapped in the blood stream, so the hyperglycemia continues to rise.

Type 1 DM

- Multi-organ system involvement
- Varied presentations
 - Acuity
 - Symptoms

Features of insulin-dependent (type 1) diabetes



Clinical Manifestations

- ⦿ **Polyuria** – an osmotic diuresis due to high blood sugar
- ⦿ **Polydipsia** – trying to correct fluid loss from polyuria
- ⦿ **Polyphagia** – feeling hungry as the body's response to “hungry cells”
- ⦿ **Dehydration** – eventually the polydipsia can't compensate the fluid loss.
- ⦿ **Weight loss** – breakdown of muscle and fat to get glucose to the cells causes unexplained weight loss.
- ⦿ **Diabetic Ketoacidosis (DKA)**

Diabetic Ketoacidosis

- ⦿ Occurs with undiagnosed or uncontrolled DM1
- ⦿ DKA is present when
 - Arterial pH is <7.25
 - Bicarb level is $< 15\text{mEq/L}$
 - Ketones are elevated in serum or urine

Pathophysiology of DKA

- ⦿ Creation of ketone bodies during fatty acid oxidation.
- ⦿ 2/3 of Ketone bodies are acids (creating a metabolic acidosis)
- ⦿ Lactic acid from severe dehydration can increase acidosis
- ⦿ Vomiting , Electrolyte abnormalities, tachypnea are all common.
- ⦿ Can result in death.

Presentation of DKA

- Polyuria, Polydipsia, nausea and vomiting
- Abdominal pain – often like an acute abdomen
- Polyuria despite a clinical picture of dehydration
- Tachypnea – trying to correct acidosis (Kussmaul breathing)
- Fruity Odor to breath (Juicy Fruit)

Labs for DKA

- ⦿ Serum Glucose – 200mg/dl to over 1000mg/dl
- ⦿ Arterial pH is <7.25
- ⦿ Bicarb level is $< 15\text{mEq/L}$
- ⦿ Ketones are elevated in serum or urine

Question

- ⦿ A 12 year old female is in the ED with abdominal pain with vomiting, fruity breath, dry mucus membranes, and irregular breathing. She is acidotic with a blood glucose of 1100. As you initiate treatment, what potential side effect do you **most** want to avoid?
- ⦿ A. Hypernatremia
- ⦿ B. Cerebral edema
- ⦿ C. Hypoglycemia
- ⦿ D. Alkalosis
- ⦿ E. Hypokalemia

Treatment of DKA

- ⦿ MUST be CAREFUL! Can get Cerebral Edema if not done properly (an endocrinologist is usually involved)
- ⦿ Dehydration – glucose free isotonic solution
- ⦿ Hyperglycemia – fast acting soluble insulin (decrease at 100mg/dl/hr)
- ⦿ Acidosis – should be corrected with insulin – bicarbonate therapy is reserved for only severe situations.
- ⦿ Electrolyte imbalances – potassium needs to be replaced.

Diabetes Type 1 - Management

- ⦿ Dependent upon age and acuity
- ⦿ Many children and adolescents will require hospitalization initially
- ⦿ Must initiate and teach:
 - Insulin treatment
 - Home glucose monitoring



Initiating Therapy

- ◎ Preferred Insulin Regimens
 - Flexible schedule
 - Provide insulin in a physiologic pattern
- ◎ Start with a moderate dose to prevent development of DKA
 - Usual starting dose is 0.5 U/kg
 - 50% given to provide basal coverage
 - 50% divided doses of rapid acting insulins

Insulin Preparations

- ⦿ Long-acting synthetic insulins (last around 24 hours)
 - Used for basal coverage
 - Insulin glargine (Lantus)
 - Insulin detimir (Levemir)
 - Not used in the insulin pump.
- ⦿ Table 171-2 p781 in Nelsons (Insulin types and duration of action)

Insulin Preparations

- ⦿ Rapid-acting synthetic
 - Used at mealtime for prandial control
 - Rapid onset – 15-20 minutes
 - Peaks at 30-45 minutes
 - Completely gone within 3 hours
 - Used in insulin pumps to provide both basal rate and mealtime boluses
 - Insulin lispro (Humalog)
 - Insulin aspart (Novolog)
 - Insulin glulisine (Apidra)

Insulin Preparations

- ⦿ Other preparations are available
- ⦿ Premixed combination insulins
 - Mix short-acting with long-acting
 - Not recommended during titration of dose
- ⦿ Dosage titrated to achieve control

Glucose Monitoring

- ⦿ A MUST if tight control is to be achieved.
 - Can help identify and minimize hypoglycemia
 - When documented and done regularly, will show patterns of hyperglycemia
 - This allows insulin adjustments that are accurate
- ⦿ Modern monitors are easy to use and accurate. Results in seconds.
- ⦿ Costs of monitoring must be considered

Home Glucose Monitoring



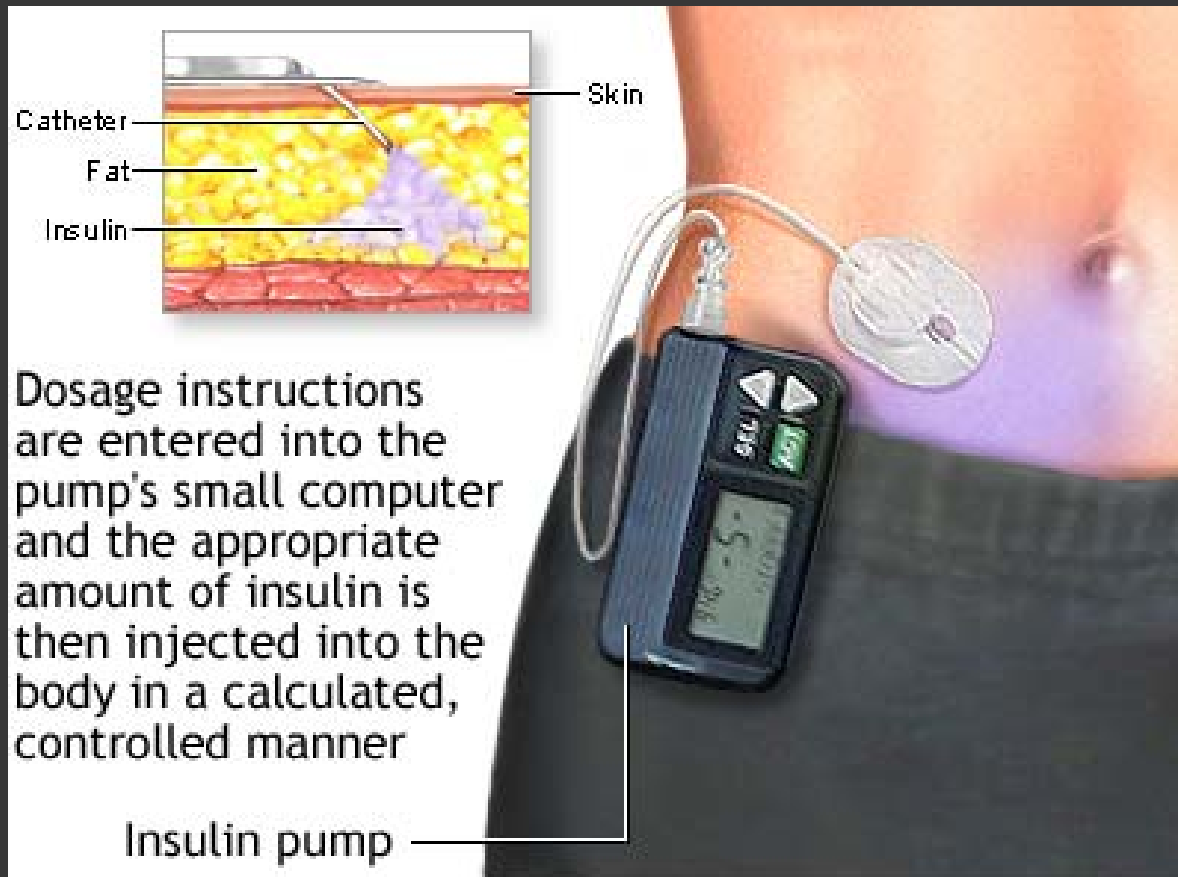
Hypoglycemia

- ⦿ Results from an excess of insulin in relation to the serum glucose concentration.
- ⦿ Patients trying to achieve tight control will have several hypoglycemic episodes per week.
- ⦿ Symptoms – headache, visual changes, confusion, irritability, seizures, tremors, tachycardia, diaphoresis, or anxiety
- ⦿ Treatment – fast acting glucose – gel, glucose tabs, fruit juice, “regular” soda, and in severe cases, glucagon injections.

Insulin Pump Therapy

- ⦿ Ideal for motivated type 1 patients
- ⦿ Combined with frequent monitoring
- ⦿ Patients must learn to make adjustments in both basal and bolus infusion rates
 - Best chance at mimicking normal physiology
- ⦿ Provides excellent chance of tight control
 - Target A1c goal for all patients 7% or less
 - Some able to achieve near normalization of A1c levels (6 to 6.5% range)

Insulin Pump Therapy



Goals of Treatment

- To delay the onset and slow the progression of complications (retinopathy, nephropathy, neuropathy)
- Hgb A1c (a 3 month average blood sugar) goal is <7.0%
 - This is a long term measurement and how treatment is going.

Supportive Care

- ⦿ Extensive formal diabetic education
 - Patient and Family
- ⦿ Instruction in dietary principles
 - Carbohydrate counting
 - Dietary consistency and control
 - Adjustment of insulin dosages
 - Dietary variations
 - Physical activity
- ⦿ Complications (e.g. hypoglycemia)

Improving Diabetic Outcomes

- ⦿ Requires a team approach
- ⦿ Patient must take “ownership” of disease management
- ⦿ All aspects of care must be under the direct control of the patient
 - Diet, medications, foot care, self-testing, etc.
- ⦿ Education is key so that patients are in control of the disease process and can anticipate changes and complications and make the necessary adjustment

Improving Diabetic Outcomes

- ⦿ Many resources are available
 - Self-help materials
 - Web sites
 - Support groups
 - Diabetic educators
- ⦿ There are many potential psychosocial problems associate with chronic disease management.
- ⦿ These must be anticipated and addressed for successful long-term management to take place

DM1 Phenomena

⦿ Honeymoon period

- New onset DM1 will occasionally has some beta cells that still function.
- See a decrease need, sometimes elimination of need for treatment
- Occurs in the first few weeks of treatment.
- Can last for a few months to a few years.
- Need for medications will return.
- Unlikely to occur in someone who presents with DKA.

DM1 Phenomena

- ⦿ Somogyi Phenomenon
 - Early morning hyperglycemia that is actually caused by hypoglycemia at night
 - The hypoglycemia causes hormones to secrete to raise blood sugar.
- ⦿ Dawn Phenomenon
 - Early morning hyperglycemia that is caused by early dosing of evening insulin and secretion of growth hormone in early morning hours
- ⦿ Distinguish between these two with monitoring at 3 am.

Question

- ⦿ An 8 year old boy develops Type 1 diabetes. He is following up in the office one year after his diagnosis for a complete physical exam. The child's mom is asking what referrals and/or tests are required at this time as she wants him monitored closely for any complications related to the diabetes. Which of the following is recommended at this time?
- ⦿ A. Ophthalmology referral
- ⦿ B. Urine microalbumin
- ⦿ C. Podiatry referral
- ⦿ D. TSH

⦿ **Lange Q&A Physician Assistant 5th Edition, pg 54

DM1 Preventative Care

- ⦿ Hgb A1c every 6 months
- ⦿ Ophthalmologic Exams every year
- ⦿ Urine checked for microalbuminuria every year
- ⦿ Annual cholesterol measurements
- ⦿ Monitoring of blood pressures
- ⦿ Thyroid blood tests every year
 - Hashimotos Thyroiditis is a common comorbid condition and symptoms can be subtle
- ⦿ Daily home foot exams and exams at every physician visit.

Presentation of *ATYPICAL* Diabetes

- ⦿ Insulin deficiency may not be absolute
- ⦿ Epidemic of childhood obesity
 - Affects adolescents and younger children
 - Familial susceptibility
- ⦿ Develop nonautoimmune diabetes
 - Preserve at least some insulin secretion
- ⦿ Increasing hyperglycemia may go unnoticed
- ⦿ Can proceed to an acute presentation
 - Hyperosmolality
 - Diabetic Ketoacidosis

Epidemic of Childhood Obesity



Presentation of *ATYPICAL* Diabetes

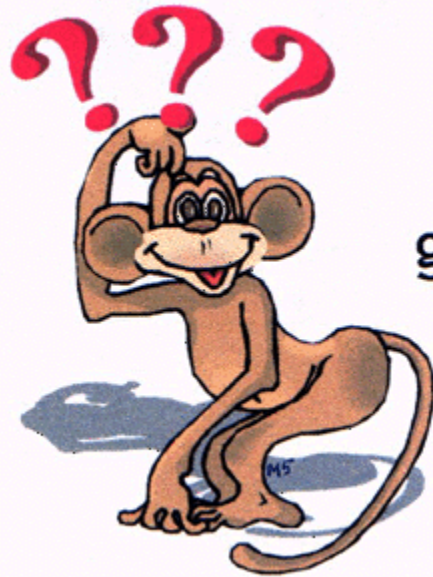
- ⦿ Most of these are obese children
- ⦿ Will have traits of insulin resistance traits
 - Like type 2 DM patients
 - or other specific forms such as MODY
- ⦿ Combinations of Type 1 traits and other mechanisms can occur in the same pt.
- ⦿ Many of these patients can be managed without insulin after the initial presentation
 - Therapeutic lifestyle measures
 - Some oral agents are now being used (Metformin)

C-Peptide

- ⦿ C-Peptide is an indicator of insulin production.
- ⦿ ↓ in C-Peptide plus symptoms = Type 1
- ⦿ Normal C-Peptide plus symptoms = Type 2

This is not an effective analysis with a late diagnosis of Type 2 – as the body will eventually stop making insulin in response to the illness.

Questions?



Questions
are
guaranteed in
life;
Answers
aren't.