Diabetes Education SERVICES

15 years

Diabetes Pathophysiology

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www.DiabetesEd.net

Lecture Objectives

1. Discuss the current epidemiologic impact of diabetes.
2. Describe the pathway of pathophysiological defects associated with the development of diabetes mellitus.
3. Describe and differentiate between the different types: prediabetes, Type 1, Type 2, LADA and GDM
4. Describe the laboratory tests used for the diagnosis of Diabetes Mellitus including FBG, OGTT, hemoglobin A1C, antibody testing and C-peptide.
5. List the characteristics that define the Insulin Resistance.
6. Differentiate between hypoglycemia, hyperglycemic crisis and the chronic macrovascular complications of DM.
7. Differentiate between hypothyroidism and hyperthyroidism and the symptoms associated with each.

Slide 2 of Important Stuff

- **Textbook Objectives**
- 1. Describe the microvascular complications associated with uncontrolled hyperglycemia (ch 18)
- 2. Explain methods for diagnosing thyroid disorders (ch 20)
- 3. Discuss the most common thyroid complications and the symptoms of each (ch 20)
- 4. List the factors that contribute to Cardiometabolic Risk (ch. 39)

Global Epidemic

- Every 10 seconds
  - 1 person dies with diabetes
  - 2 people develop diabetes
- Every year
  - 3 million deaths
  - 6 million new cases
- World Diabetes Day is November 14
- March is ADA Sound the Alert Day "find people w/ undetected diabetes"

World Diabetes Day

November 14

CDC Announces

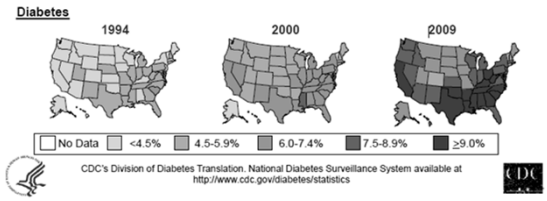
35% of Americans will have Diabetes by 2050

Boyle, Thompson, Barker, Williamson 2010, Oct 22:8(1)29

www.pophealthmetrics.com

Diabetes in America 2014

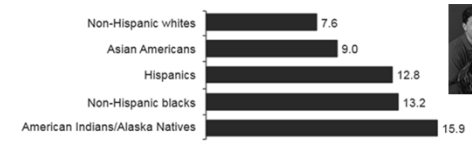
- 29 million or > 9.3%
- 27% don't know they have it
- 37% of US adults have pre diabetes (79 mil)



Age-adjusted Diabetes Prevalence

20 yrs or older, by race/ethnicity— U.S. 20014

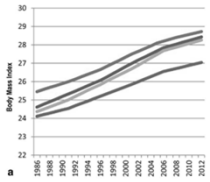
Age-adjusted* percentage of people aged 20 years or older with diagnosed diabetes, by race/ethnicity, United States, 2010–2012



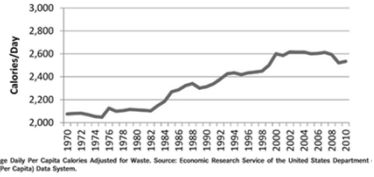
*Based on the 2000 U.S. standard population.
Source: 2010–2012 National Health Interview Survey and 2012 Indian Health Service's National Patient Information Reporting System.

- Among Hispanic adults, the age-adjusted rate of diagnosed diabetes was 8.5% for Central and South Americans, 9.3% for Cubans, 13.9% for Mexican Americans, and 14.8% for Puerto Ricans.
- Among Asian American adults, the age-adjusted rate of diagnosed diabetes was 4.4% for Chinese, 11.3% for Filipinos, 13.0% for Asian Indians, and 8.8% for other Asians.
- Among American Indian and Alaska Native adults, the age-adjusted rate of diagnosed diabetes varied by region from 6.0% among Alaska Natives to 24.1% among American Indians in southern Arizona.

Obesity and Economics in America



- ~~68% overweight or obese~~
  - 34% BMI 30 +, 34% BMI 25-29
- 1/3 of all overwt people don't get diabetes
- We burn 100 cals less a day at work
- Overall, food costs ~ 10-15% of income
- Calorie Intake is on the rise



Average Daily Per Capita Calories Adjusted for Waste. Source: Economic Research Service of the United States Department ... ility (Per Capita) Data System.

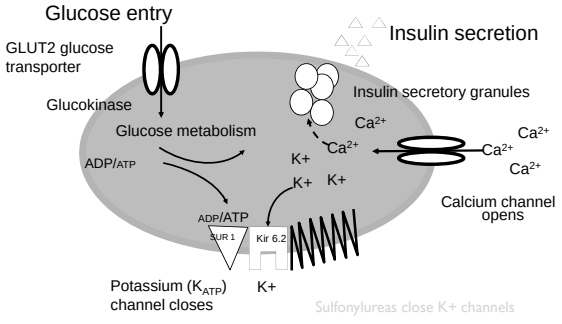
32% of Medicare dollars go to Treat diabetes.

- **2012 - Total cost of diabetes $245 billion**
  - **Indirect costs:** $69 billion (disability, work loss, premature mortality)
- People with diabetes had 2-4 x's greater medical expenditures

- The largest components of medical expenditures are:
  - 43% - hospital inpatient care
  - 18% - prescription meds to treat complications
  - 12% - diabetes meds supplies
  - 9% - physician office visits
  - 8% - nursing/residential facility stays

Insulin Secretion by the β-Cell

Roles of Glucose, K^+, and Ca^{2+}



Pancreas – Hormones that lower BG

Beta Cells - Insulin

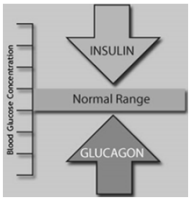
Anabolic hormone - helps store glucose as glycogen in muscle, liver

- secreted in response to elevated glucose
- halts breakdown of glycogen in liver
- increases protein synthesis, fat storage
- powerful hypoglycemic

Beta Cells - Amylin

- secreted in 1:1 ratio with insulin
- Causes satiety
- Lowers post-prandial glucagon response
- Slows gastric emptying
- Type 1 make none
- Type 2 make less than normal amounts

Pancreas – Hormone Raises BG



Alpha cells - Glucagon

Opposes action of insulin at the liver

- stimulated in response to low glucose levels
- stimulates liver to convert glycogen to glucose
- inhibits liver from glucose uptake
- causes hyperglycemia

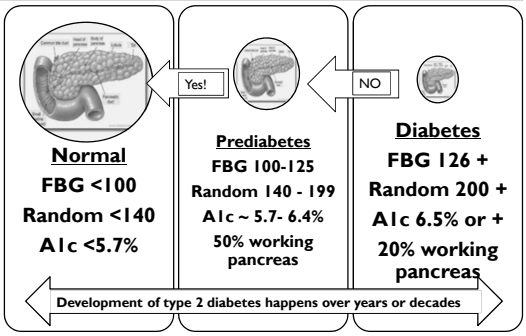
Hormones Effect on Glucose

Hormone	Effect
Glucagon (pancreas)	↑
Stress hormones (kidney)	↑
Epinephrine (kidney)	↑
Insulin (pancreas)	↓
Amylin (pancreas)	↓
Gut hormones - incretins (GLP-1) released by L cells of intestinal mucosa, beta cell has receptors)	↓

Signs of Diabetes

- Polyuria → Glycosuria, H_2O losses
- Polydipsia → Dehydration
- Polyphasia → Fuel Depletion
- Weight loss → Loss of body tissue, H_2O
- Fatigue → Poor energy utilization
- Skin and other infections → Hyperglycemia increases incidence of infection
- Blurry vision → Osmotic changes

Natural History of Diabetes



Diagnostic Criteria

- All test should be repeated in the absence of unequivocal hyperglycemia
- If test abnormal, repeat same test to confirm diagnosis on a different day
- If one test normal, the other abnormal, repeat the abnormal test to determine status
- Medicare still using fasting as criteria for reimbursement for education

What Kind of Diabetes?

AJ, a 22 year old female admitted to the ICU with a blood glucose of 476 mg/dl and a pH of 7.1.

- What further questions and or testing is needed to determine if patient has type 1 or type 2 diabetes?

Type 1 Diabetes

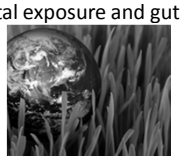
Type 1 Diabetes Facts

- As many as **3 million Americans** may have type 1 diabetes.
- Each year, approximately **80 people per day** are diagnosed with type 1 diabetes in the U.S.
- Approximately **85 percent** of people living with type 1 diabetes are adults, and **15 percent** are children.
- The rate of type 1 diabetes incidence among children under age 14 is estimated to **increase by 3 percent annually** worldwide.
- Type 1 diabetes accounts for **$14.9 billion** in healthcare costs in the U.S. each year.

Source: JDRF

Type 1 Rates Increasing Globally

- 23% rise in type 1 diabetes incidence from 2001-2009
- Why?
  - Autoimmune disease rates increasing over all
  - Changes in environmental exposure and gut bacteria?
  - Hygiene hypothesis
  - Obesity?



Incidence of Type 1 in Youth

- **General Pop 0.3%**
- **Sibling 4%**
- **Mother 2-3%**
- **Father 6-8%**
- Rate doubling every 20 yrs
- Many trials underway to detect and prevent (Trial Net)

Type 1 – 10% of all Diabetes Genetics and Risk Factors

- Auto-immune pancreatic beta cells destruction
- Most commonly expressed at age 10-14
- Insulin sensitive (require 0.5 - 1.0 units/kg/day)

- Combo of genes and environment:
  - Autoimmunity tends to run in families
  - Higher rates in non breastfed infants
  - Viral triggers: congenital rubella, coxsackie virus B, cytomegalovirus, adenovirus and mumps.

Type 1 Diabetes – Genetics and Risk Factors

- Combo of genes and disease susceptibility
- Risk Factors:
  - Autoimmunity tends to run in families
  - Higher rates in non breastfed infant
  - Viral triggers: congenital rubella, coxsackie virus B, cytomegalovirus, adenovirus and mumps.
- Living longer (avg age expectancy 68.5)

How do we know someone has Type 1 vs Type 2?

- Type 1
  - Positive antibodies
    - GAD
    - ICA
    - IAA and others
- Younger people develop quickly
- Older people take longer to develop
- Body wt and presentation

Autoantibodies Assoc w/ Type 1

Panel of autoantibodies –

- GAD65 - Glutamic acid decarboxylase –
- ICA - Islet Cell Cytoplasmic Autoantibodies
- IAA - Insulin Autoantibodies

Type 1 Diabetes Associated with other immune conditions

- Celiac disease (gluten intolerance)
- Thyroid disease
- Addison's Disease
- Rheumatoid arthritis
- Other

Type 1 in Hospital

- 43 yr old admitted to evaluate angina.
- Morning blood sugar is 92.
- Based on Regular insulin sliding scale, no insulin required.
- Breakfast tray shows up and patient says, I need my insulin shot before I eat.

What do you say?

Type 1 Summary

- Autoimmune pancreatic destruction
- Need insulin replacement therapy
- Often first present in DKA
- At risk for other autoimmune diseases

What kind of Diabetes?

- Pt is 58, states she has had type 1 diabetes for 18 years. Quit smoking a year ago and gained about 20 lbs. BMI 25.
- Meds
  - Humalog 18-23 units before each meal
  - Lantus 28 units at bedtime
  - Metformin 500mg TID
- What tests would you recommend?

What type of Diabetes?

- 72 Years old
- A1c 3 months prior 6.2%
- A1c now 13.9%
- BMI 24.5
- Lost about 10 pounds over last month

Latent AutoImmunity Diabetes in Adults (LADA)

- Antibody positive to 1-2 of below
  - GAD-65 autoantibodies
  - Insulin Autoantibodies
  - Islet Cell antigen-2
- Adult Age at onset
- Usually need insulin w/in first 6 months of diagnosis
- Early insulin therapy may preserve beta cell function

Diabetes Care 26:536-538, 2003
Jerry P. Palmer, MD and Irl B. Hirsch, MD

LADA Clinical Features Compared to Type 2

Feature	LADA	Type 2
Age <50	63%	19%
Acute hyperglycemia	66	24
BMI < 25	33	13
Hx of autoimmune dx	27	12
Family hx autoimmune	46	35

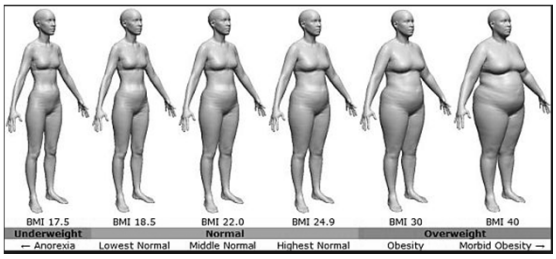
Practical Diabetology March 08, Unger MD

Life Study – Mrs. Jones

Mrs. Jones is 62 years old, overweight and complaining of feeling tired and urinating several times a night. She is admitted with a urinary tract Infection. Her WBC is 12.3, glucose 237. She is hypertensive with a history of gestational diabetes. No ketones in urine.

- What are her risk factors, signs of diabetes
- What type of diabetes does she have?
- Does she have insulin resistance?

BMI – Visual Image



Diabetes 2 - Who is at Risk?

(ADA Clinical Practice Guidelines)

1. Testing should be considered in all adults who are overweight (BMI ≥ 25) and have additional **risk factors**:
   - First-degree relative w/ diabetes
   - Member of a high-risk ethnic population
   - Habitual physical inactivity
   - PreDiabetes
   - History of heart disease

Diabetes 2 - Who is at Risk?

(ADA Clinical Practice Guidelines)

Risk factors cont'd

- HTN - BP > 140/90
- HDL < 35 or triglycerides > 250
- baby >9 lb or history of Gestational Diabetes Mellitus (GDM
- Polycystic ovary syndrome (PCOS)
- Other conditions assoc w/ insulin resistance:
  - Severe obesity, acanthosis nigricans (AN)

Acanthosis Nigricans (AN)

- Signals high insulin levels in bloodstream
- Patches of darkened skin over parts of body that bend or rub against each other
  - Neck, underarm, waistline, groin, knuckles, elbows, toes
  - Skin tags on neck and darkened areas around eyes, nose and cheeks.
- No cure, lesions regress with treatment of insulin resistance

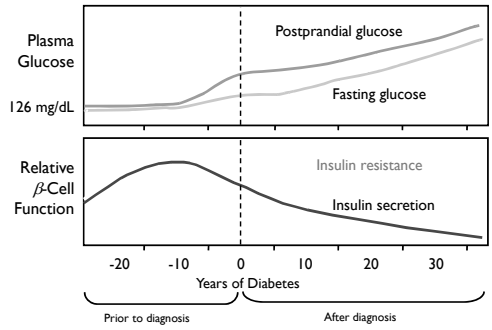
What is Type 2 Diabetes?

- Complex metabolic disorder ….
  (Insulin resistance and deficiency)

with social, behavioral and environmental risk factors unmasking the effects of genetic susceptibility.

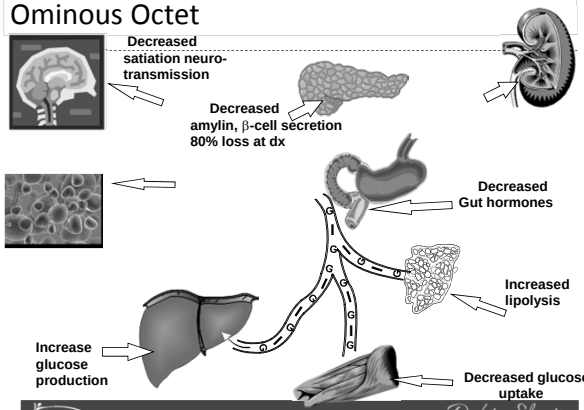
New Diagnosis?
Call 800 – DIABETES to request "Getting Started Kit"
www.Diabetes.org

Natural Progression of Type 2 Diabetes



Adapted from Bergenstal et al. 2000; International Diabetes Center.

Ominous Octet



What Do You Say? Mrs. Jones asks you

- What is type 2 diabetes?
- Will this go away?
- Will I get complications?
- Will I need to take diabetes medication for the rest of my life?
- How come I got diabetes?
- Do I have to check my blood sugars?

Overcoming barriers

- Confront the key misbelief. Ask the question, does dm cause complications?
- Offer pts evidence based hope message –
- Frequent contact
- Paired glucose testing
- Ask pt, "Tell me 1 thing that is driving you crazy about your diabetes"
- Discuss medication beliefs
- To improve outcomes, see pts more often

Bill Polonsky, PhD, CDE

Comparison of Type 1,Type 2, LADA

	Type 1	Type 2	LADA
Obesity	x	xxx	x
Insulin dependence	xxx	30%	6mos
Respond to oral agents	0	xxx	x
Ketosis	xxx	x	x
Antibodies present	xxx	0	xx
Typical Age of onset	teens	adult	adult
Insulin Resistance	0	xxx	x

Diabetes is also associated with

- Fatty liver disease
- Obstructive sleep apnea
- Cancer; pancreas, liver, breast
- Alzheimer's
- Depression

Other Types of Diabetes

- Gestational
- Other specific types of diabetes

Gestational DM ~ 7% of all Pregnancies

- GDM prevalence increased by
  - ~10–100% during the past 20 yrs
- Native Americans, Asians, Hispanics, African-American women at highest risk
- Immediately after pregnancy, 5% to 10% of GDM diagnosed with type 2 diabetes
- Within 5 years, 50% chance of developing DM in next 5 years.

Increasing Prevalence – A public health perspective

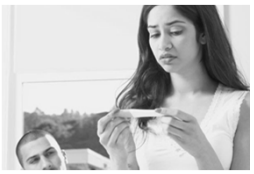
- Body weight before and during pregnancy influences risk of GDM and future diabetes
- Children born to women with GDM at greater risk of diabetes
- Focus on prevention

Diabetes in pregnant mothers associated with …

- Offspring
  - Fetal Complications
  - Obesity and diabetes later in life
- Mother
  - More complicated pregnancy and delivery
  - Diabetes later in life
- Intrauterine environment is important

Screen Pregnant Women Before 13 weeks

- Screen for undiagnosed Type 2 at the first prenatal visit using standard risk factors.
- Women found to have diabetes at their initial prenatal visit treated as "Diabetes in Pregnancy"
- If normal, recheck at 24-28 weeks



Postpartum after GDM

- 50% risk of getting diabetes in 5 years
- Screen at 6-12 wks post partum
- Repeat at 3 yr intervals or signs of DM
  - Encourage Breast Feeding
  - Encourage weight control
  - Encourage exercise
  - Make sure connected with health care
  - Lipid profile/ follow BP
  - Preconception counseling

DiaBingo

B Frequent skin and yeast infections
B A BMI of ____ or greater is considered overweight
B To reduce complications, control A1c, Blood pressure, Cholesterol
B PreDiabetes – fasting glucose level of ___ to ____
B Erectile dysfunction indicates greater risk for ____
B Diabetes – fasting glucose level____ or greater
B Type 1 diabetes is best described as an _____ disease
B People with diabetes are _____ times more likely to die of heart dx
B Elevated triglycerides, < HDL, smaller dense LDL
B Each percentage point of A1c = _____ mg/dl glucose
B At dx of type 2, about __% beta cell function is lost
B Diabetes – random glucose ____ or greater

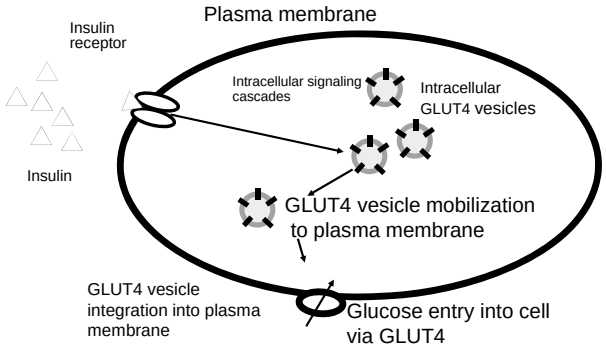
Hyperglycemia and Insulin Resistance – From Head to Toe

Objectives

- Describe the impact of insulin resistance
- State the factors associated with of cardiometabolic risk.
- State strategies to maintain oral health and keep lower extremities healthy

Insulin Action in Muscle and Fat Cells

Mobilization of GLUT4 to the Cell Surface



GLUT4=glucose transporter 4

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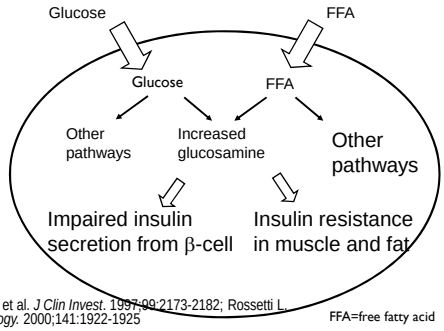
Mechanism of Glucotoxicity and Lipotoxicity

The Glucosamine Hypothesis



Hawkins M et al. *J Clin Invest*. 1997;99:2173-2182; Rossetti L. *Endocrinology*. 2000;141:1922-1925

FFA=free fatty acid

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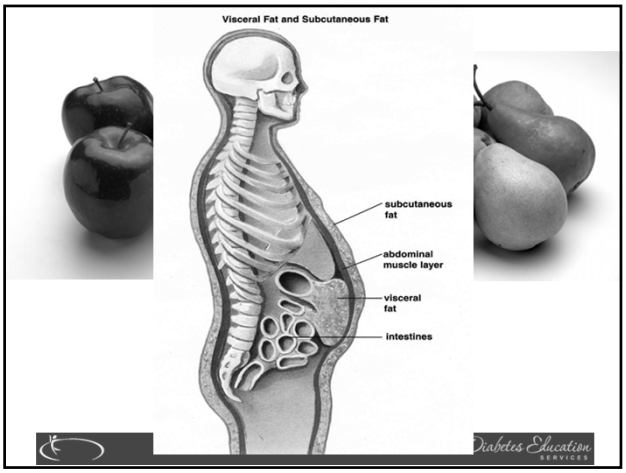

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Insulin Resistance is the Seed

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Factors Associated with Insulin Resistance

- Abdominal obesity
- Sedentary lifestyle
- Genetics / Ethnicity
- Gestational Diabetes
- Polycystic ovary syndrome
- Acanthosis Nigricans
- Obstructive Sleep Apnea
- Cancer

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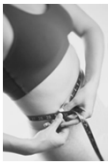
Cardio Metabolic Risk - 5 Hypers -

- Hyperinsulinemia (resistance)
- Hyperglycemia
- Hyperlipidemia
- Hypertension
- Hyper"waistline"emia (35" women, 40" men)



Manifestations of Insulin Resistance

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The Link Between Hyperglycemia, Insulin Resistance and Cardiovascular Disease

Heart Disease & DM = 3-5xs Risk

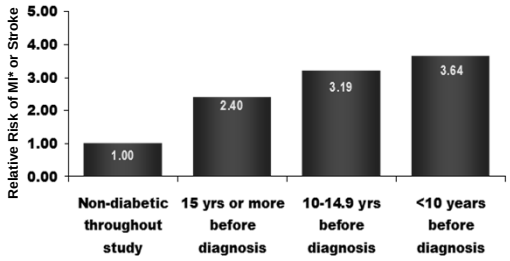
- CHF
  - 7.9 % w/ diabetes vs.
  - 1.1 % no diabetes
- Heart attack
  - 9.8 % w/ diabetes vs.
  - 1.8 % no diabetes
- Coronary heart disease
  - 9.1 % w/ diabetes vs.
  - 2.1 % no diabetes
- Stroke
  - 6.6 % w/ diabetes vs.
  - 1.8 % no diabetes

- 2007 AACE

Vascular Disease & Diabetes "atherosclerosis"

- Normal endothelial cells are protective
- Abnormal glucose = Endothelial cell dysfunction
  - Lower Nitric Oxide levels = Poor vasodilation
  - Release of inflammatory mediators
  - Higher aldosterone levels
  - Adipokines = > angiotensin = HTN
  - = Increased risk of acute thrombotic event
- Increased arterial stiffness
  - Due to chronic hyperglycemia, endothelial inflammation

Risk of CVD Is Elevated prior to Diagnosis of Type 2 Diabetes

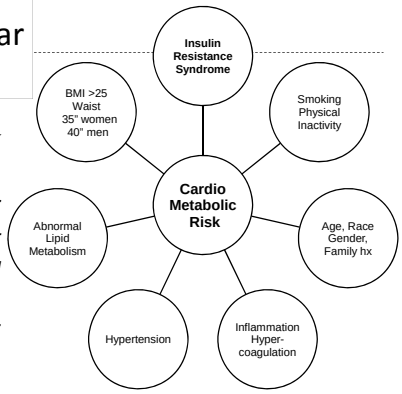


*MI = myocardial infarction. Nurses Health Study

Adapted from Hu F, et al. *Diabetes Care.* 2002;25:1129-1134.

CardioVascular Risk Factors

The more risk factors = greater risk of heart disease and diabetes
ADA 2007



People with Diabetes in the Dark about CVD Link

- Recent survey of 2000 pt's w/ DM
- 68% did not consider CVD a complication of diabetes
- Only 17% thought DM increased risk of CVD

Survey: American Diabetes Association and American College of Cardiology

Bottom Line

- Cardiovascular disease is the leading cause of death for people with diabetes
- 65% of people with diabetes die from heart disease (36% in general population)
- Prevention and aggressive treatment of diabetes is critical

Now on to Hyperglycemic Crisis

Diabetes KetoAcidosis

- 135,000 Hospitalizations a year
- $2.4 billion U.S. dollars spent on treatment
- Often a cry for help

ADA article on Hyperglycemic Crises

DKA Precipitating Factors

- 25 -30% of time, illness and infection
  - increases stress hormone release
- 50% inadequate insulin dosage
- initial manifestation of type 1
- emotional stress - especially teens, neglect or mismanagement

Extreme Hyperglycemia – Diabetes KetoAcidosis (DKA)

- DKA - profound insulin deficiency
- Excess stress hormones such as glucagon, epinephrine, and cortisol render insulin less effective
- Excess glucose production by liver
- Lipolysis leads to FFA's and ketones
- Osmotic diuresis, dehydration, lyte imbalances, acidosis

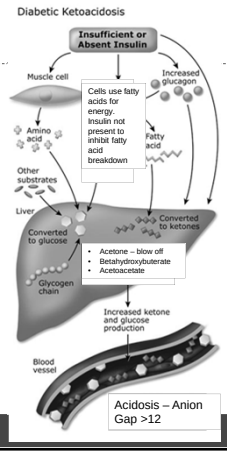
DKA Signs and Symptoms

- hyperglycemia- leads to weakness, lethargy, malaise, headache
- GI symptoms - N/V, abd pain
- Kussmaul's deep, rapid breathing
- hypothermia, acetone breath
- hyperpnea - to rid acidosis
- changes in mentation, hyporeflexia/tonia
- dehydration, ortho hypo

DKA

Pathophysiolgy

DKA explained clearly
Video



Extreme Hyperglycemia – Hyperosmolar Hyperglycemic State (HHS)

- occurs in elderly pt's w/ type 2 - esp if not closely monitored
- often precipitated by illness or stress
- symptoms may go unrecognized for wks
- massive fluid loss from osmotic diuresis
  - burns, hyperglycemia, diarrhea, hemodialysis, diuretics, steroids
- MI, infections, hypertonic feedings

DKA vs HHS

- Usually < 40 yrs old
- < 2 days symptoms
- Glucose >250
- Serum Ketones: +++
- pH low (<7.3)
- Anion Gap > 12
- Usually Type 1
- 3 – 10% mortality

- Usually >60 yrs old
- > 5 days symptoms
- Glucose >600
- Ketones: none to +
- pH normal (>7.3)
- Usually Type 2
- 10 - 20% mortality

DKA - HHS Presentation and Action

- Labs
  - NA - low to high
  - K+ - moves into vascular space
  - Hct and Hgb ↑ dehydration
  - BUN / Creatinine ↑
  - WBC ↑ (no infect)
  - pH low to normal
- Action
  - maintain insulin drip until ketone neg, glucose <200
  - maintain hydration
  - check BG q1 hour
  - assess lytes (esp K+)
  - give sub-Q insulin before d/c IV insulin
  - teach, teach, teach

DKA and HHS

5 most important interventions

- Fluids (NS, →0.45 NS, →D51/2 NS once glucose 300mg/dl)
- Insulin (.05 - 0.1unit/kg per hour)
- Potassium / lyte replacement
  - (K^+, Mg, Ca, Phos)
- Determine, treat precipitating cause
- Education to prevent future episodes

Hypoglycemia prevention

- 72 yr old, thin, lives alone, A1c 7.3%. History of MI, stroke. DM for 12 yrs, takes glyburide 10mg BID. Limited income. Creat 1.4.
- What strategies

To prevent lows?

Hypoglycemia – "Limiting Factor"

- Defined as glucose of 70mg/dl or below
- 50% of episodes occur during night
- Higher mortality rate with severe hypoglycemia secondary to sulfonylureas
  - Especially glyburide
- Blood glucose levels don't describe severity, response is individual

Glycemic Threshold Values

John White, PharmD, Diabetes Spectrum, 2007

Classification	BG	Physical Response
Lower euglycemia	80-90's	Endogenous insulin
Hypoglycemia	70's	Glucagon, adrenaline
Symptoms	60s	Growth hormone, cortisol
	50's	Cognitive deterioration
Neuroglycopenia	40's	
	30's	
Severe	20's	Coma, seizures
neuroglycopenia	10	

(shortage of glucose in the brain affects function of the neurons)

Hypoglycemia Awareness

- autonomic symptoms adrenergically based
- after 2-5 yrs of type 1 dm,
  - glucagon secretion impaired
  - epinephrine secretion becomes primary mechanism to restore BG levels
- over time, epi response diminished or delayed
- decreases awareness of hypo and hormonal response

Hypoglycemia Symptoms

- Autonomic
  - Anxiety
  - Palpitations
  - Sweating
  - Tingling
  - Trembling
  - Hypoglycemic Unawareness
- Neuroglycopenia
  - Irritability
  - Drowsiness
  - Dizziness
  - Blurred Vision
  - Difficulty with speech
  - Confusion
  - Feeling faint

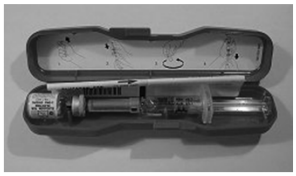
Treatment of Hypoglycemia

- If blood glucose **70**mg/dl or below:
  - 10-15 gms of carb to raise BG 30 - 45mg/dl
- Retest in 15 minutes, if still low, treat again, even without symptoms
- Follow with usual meal or snack
- If BG less than 40, allow recovery time

Tx of Severe Hypoglycemia

- If can swallow w/out risk of aspiration, try gel, honey, etc. inside cheek
- If unable to swallow, D50 IV or Glucagon
- Glucagon injection – teach support person
  - Dosing:
    - Adults 1mg
    - Children <20kg 0.5mg
  - Glycemic effect 20 - 30mg, short lived
  - Must intake carb as soon as able
  - Need prescription, check exp. date

Glucagon Emergency Kit



Store 68-77 degrees prior to reconstitution
single use only

Thyroid Disease and Diabetes

- 27 mil Americans have over or under active thyroid glands, but more than half remain undiagnosed.
- More than 8 out of 10 pts w/ thyroid disease women.
- 15 to 30% of people w/ diabetes & their siblings or parents are likely to develop thyroid disease (compared to 4.5 percent of the general population).
- Check TSH on Type 1 & 2 annually or if indicated.

AACE Website

Thyroid & TSH* Levels

AACE 2012 Guidelines

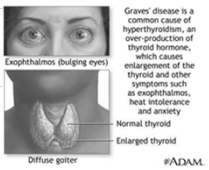
- *Thyroid Stimulating Hormone - secreted by pituitary gland
  - controls thyroid hormone thyroxine production
  - first and best test
  - TSH Norm = up to 4.5 mIU/mL
  - Treatment based on TSH plus symptoms.
    - 4.5 – 10 based on risk, s/s
    - 10 or more = treat
  - Lower = hyperthyroidism
  - Higher = hypothyroidism

Hypothyroidism

- Hashimoto's thyroiditis – autoimmune thyroid
  - most common cause of hypothyroidism w/ dm
- Type 1 and type 2 at greater risk
- Screen annually for thyroid disease in diabetes
- Clinical features: fatigue, wt gain, dry skin, cold intolerance, depression, constipation, dyslipidemia
  - Higher risk of CVD – monitor risk
- Dx: high TSH, then test for free T4, autoantibodies, and thyroid scans as needed
- Tx: replacement with levothyroxine (75-125 ug)

AACE Thyroid Guidelines

Hyperthyroidism



- Graves Disease (most common)
- 0.5 – 2.0% risk in type 1
- Autoimmune disorder:
  - Symptoms: wt loss, hypermetabolism, tremor, exopthalmus, palpitations, tachycardia, heat intolerance, nervousness, hyperglycemia
  - Diagnosis: Dx: low TSH, then check T3 & T4, autoantibodies, and thyroid scans
  - Treatment: antithyroid drugs, surgery, radioactive iodine. After treatment, may need thyroid replacement therapy.

AACE Thyroid Guidelines 2002