Drug-Induced Hyperglycemia

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Outline

- Risk Factors
- Presentation
- Causative Agents
- Mechanisms
- Prevention
- Management

Risk Factors

- General Diabetes risk factors, plus:
  - Pre-existing or underlying Diabetes
  - Higher doses of thiazides or corticosteroids
  - Use of more than one drug that can induce hyperglycemia
  - Polypharmacy

Presentation of Drug-Induced Hyperglycemia

Mild-to-Moderate

- Blurred vision
- Excessive thirst
- Fatigue/weakness
- Polydipsia
- Polyphagia
- Polyuria
- Unexplained weight loss
- Increased Blood Glucose

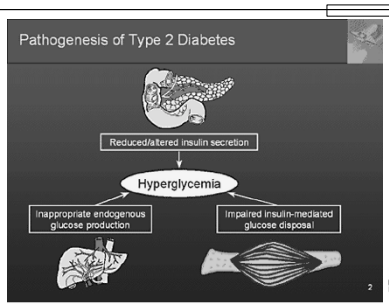
Severe disease

- Abdominal Pain, N/V
- Coma
- Dehydration
- Hypokalemia
- Hypotension
- Kussmaul respiration and fruity breath
- Lethargy
- Metabolic acidosis

Causative Agents

- Atypical antipsychotics
- B-blockers
- Cyclosporine
- Diazoxide
- Thiazide Diuretics
- Fish oil
- Glucocorticoids
- Growth Hormone
- Interferons
- Megesterol
- Nicotinic acid
- Oral contraceptives
- Pentamidine
- Phenothiazines
- Phenytoin
- Protease inhibitors
- Rifampin
- Ritodrine
- Tacrolimus
- Terbutaline
- Thalidomide

Mechanisms



DECREASE INSULIN SECRETION

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Thiazide Diuretics

- High doses
- Hypokalemia
- "Each 0.5mEq/L decrease in serum potassium was associated with a 45% higher risk of new diabetes"
- Plan: Use smaller doses (12.5-25mg/day HCTZ) and replace potassium

Shafi T. Hypertension. 2009 Feb;53(2):e19.

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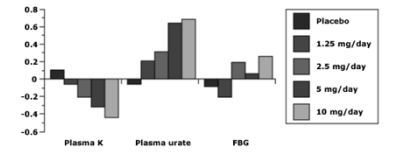
Dose-dependence of thiazide-induced side effects



Metabolic complications induced by bendrofluazide in relation to daily dose (multiply by 10 to get equivalent doses of hydrochlorothiazide). Increasing the dose led to progressive hypokalemia and hyperuricemia and a greater likelihood of a mild elevation in the fasting blood glucose (FBG), all without a further reduction in the systemic blood pressure. Each treatment group contained approximately 52 patients.
Data from Carlsen, JE, Kober, L, Torp-Pedersen, C, Johannsen, P, BMJ 1990; 300:975.

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Immunosuppressants

- Overall incidence 4-46%
- Pre-disposing factors
  - Genetics
  - Metabolic syndrome
  - Increasing age
- Most common in the first few months post-transplant

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Immunosuppressants

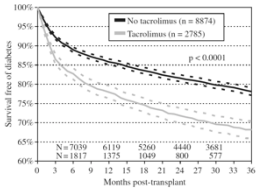

Figure 2: Survival free of post-transplant diabetes for patients treated without (solid black line) and with (solid gray line) tacrolimus as initial maintenance immunosuppressive medication. The dashed lines indicate the 95% confidence intervals. The numbers above the *X*-axis indicate the total number of patients surviving with a functioning graft free of diabetes at that time (upper row for patients treated without, and lower row for patients treated with tacrolimus).

Kasiske BL. American Journal of Transplantation 2003; 3: 178–185

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Immunosuppressants

Immunosuppressive Agent	Incidence of Diabetes
Tacrolimus	+++++
Sirolimus	++++
Cyclosporine	+++
Azathioprine	--
Mycophenolate	--

Woodward RS. Value Health. 2011 Jun;14(4): 443-9

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Antipsychotics

Table 2 — Metabolic abnormalities associated with atypical antipsychotic drugs[2]

Drug	Weight gain	Risk for diabetes	Worsening lipid levels
Clozapine	+++	+	+
Olanzapine	+++	+	+
Risperidone	++	Conflicting results	Conflicting results
Quetiapine	++	Conflicting results	Conflicting results
Aripiprazole[a]	±	–	–
Ziprasidone[a]	±	–	–

[a] Limited long-term data as of 2004.

Psychiatric Times, MAY 20, 2011

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Beta Blockers

- Especially non-selective for B1-subtype
  - Propranolol
  - Nadolol
- ARIC Study

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ARIC Study

- METHODS:
- Prospective study with 12,550 patients
- Hypertension, with no diabetes
- ENDPOINTS:
- New onset diabetes after three and five years

Gress TW. N Engl J Med. 2000 Mar 30;342(13): 905-12

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ARIC Study

TABLE 3. RISK OF DIABETES MELLITUS AMONG 3804 SUBJECTS WITH HYPERTENSION, ACCORDING TO CATEGORY OF ANTIHYPERTENSIVE MEDICATION.*

ANTIHYPERTENSIVE MEDICATION	HAZARD RATIO (95% CONFIDENCE INTERVAL)		
	MODEL 1	MODEL 2	MODEL 3
None	1.0	1.0	1.0
ACE inhibitor	0.99 (0.73–1.35)	0.96 (0.71–1.31)	0.98 (0.72–1.34)
Beta-blocker	1.26 (1.03–1.52)†	1.25 (1.03–1.52)†	1.28 (1.04–1.57)†
Calcium-channel antagonist	1.17 (0.85–1.62)	1.16 (0.84–1.60)	1.17 (0.83–1.66)
Thiazide diuretic	0.95 (0.77–1.17)	0.93 (0.76–1.15)	0.91 (0.73–1.13)

*Model 1 adjusted for age, sex, race, and use of other antihypertensive medications. Model 2 adjusted for the variables included in model 1, as well as body-mass index, waist-to-hip ratio, level of education, smoking status, alcohol use, and physical-activity level. Model 3 adjusted for the variables included in model 2, as well as systolic blood pressure, diastolic blood pressure, fasting serum insulin concentration, and the presence or absence of hypercholesterolemia, cardiovascular disease, pulmonary disease, renal insufficiency, and a family history of diabetes. ACE denotes angiotensin-converting enzyme.

†$P<0.05$ for the comparison with subjects taking no antihypertensive medication.

Gress TW. N Engl J Med. 2000 Mar 30;342(13): 905-12

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CAUSE INSULIN RESISTANCE

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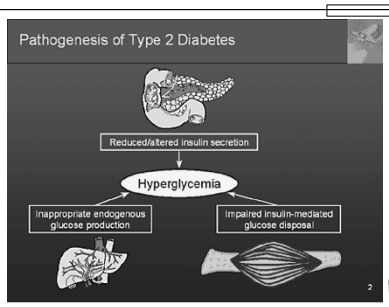
Mechanisms



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Glucocorticoids

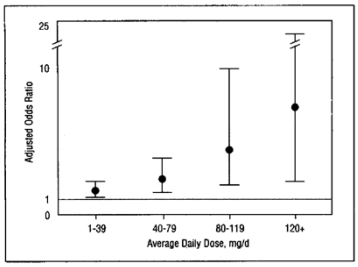

Figure 2. *Adjusted odds ratios for the initiation of hypoglycemic therapy according to average daily glucocorticoid dose in hydrocortisone-equivalent milligrams. Brackets indicate 95% confidence intervals.*

Gurwitz JHArch Intern Med. 1994 Jan 10;154(1): 97-101.

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Oral Contraceptives

Agents	Hyperglycemic effect
Older Agents	+++++
Newer Agents	+++
Bi- and Tri-phasic	+

CARDIA trial

Kim C. Diabetes Care 25:1027–1032, 2002

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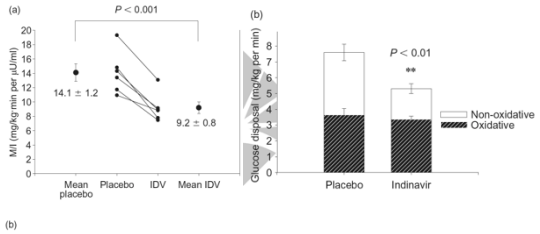
Protease Inhibitors



Noor MA. AIDS. 2006;20(14):1813.
AIDS. 1998 Oct 22;12(15):F167-73.

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INCREASE HEPATIC GLUCOSE PRODUCTION

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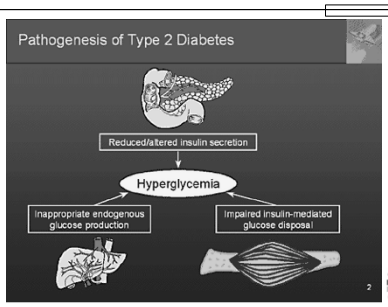
Mechanisms



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Nicotinic acid

Niacin ER 2000 mg lead to 5% increase in serum glucose

Guyton JR. Am J Cardiol. 1998 Sep 15;82(6):737-43.

	Baseline HbA1c	Week 16 HbA1c	% Change
Placebo	7.13% (0.12%)	7.1% (0.13%)	-0.02%
1000 mg	7.23% (0.14%)	7.4% (0.19%)	+0.07%
1500 mg	7.21% (0.11%)	7.5% (0.14%)	+0.29%

Grundy SM. Arch Intern Med. 2002;162:1568-1576

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Nicotinic Acid

TABLE 2. Effect of nicotinic acid treatment on FSIGT measures

	Young NGT		Old NGT		Old IGT		*P* value		
	Placebo	Nicotinic acid	Placebo	Nicotinic acid	Placebo	Nicotinic acid	Group effect	Treatment effect	Interaction
n	15	15	16	16	14	14			
Fasting glucose (mM)	5.1 ± 0.1	5.3 ± 0.1	5.2 ± 0.1	5.6 ± 0.1	5.3 ± 0.1	6.2 ± 0.2	0.006[a]	<0.0001	0.002[a]
Fasting insulin (pM)	69 ± 9	131 ± 26	54 ± 4	116 ± 10	62 ± 6	127 ± 14	0.59	<0.0001	0.99

Mean ± SE.
[a] Old IGT *vs.* young and old NGT.

Chang AM. J Clin Endocrinol Metab, September 2006, 91(9):3303–3309

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HMG-CoA Reductase Inhibitors

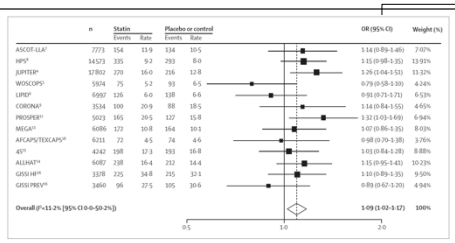

Figure 2: Association between statin therapy and incident diabetes in 13 major cardiovascular trials†
†Events per 1000 patient-years. ‡Weights are from random effects analysis.

Sattar N. Lancet. 2010;375(9716):735

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PREVENTION OF DRUG-INDUCED DIABETES

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Prevention

- Identify high-risk patients
- Monitor blood glucose levels
- Use lowest effective dose for shortest possible duration
- Alter therapy when necessary and possible

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MANAGEMENT OF DRUG-INDUCED DIABETES

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Management

- Reduce risk factors
- Replace causative agent whenever possible
- Administer anti-diabetic agents if Diabetes develops

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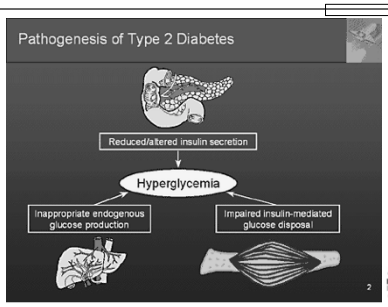
Mechanisms



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QUESTIONS?

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Patient Education in Diabetes

Lindsay Coleman, Pharm.D.
Pharmacy Practice Resident
University of Arkansas for Medical Sciences

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Outline

- Disease state management
- Treatment goals
- Lifestyle recommendations
- Complications
- Medications

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Diabetes Overview

- Chronic disease of glucose metabolism
- At least one in every twelve people has diabetes
- Self-managed and controllable:
  - Proper meal planning
  - Exercise
  - Medication, if needed

National Diabetes Information Clearinghouse. National Diabetes Statistics 2011. http://diabetes.niddk.nih.gov/dm/pubs/statistics/. Accessed August 2012

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ADA Position Statement

"Diabetes self-management education is a critical element of care for all people with diabetes and is necessary in order to improve patient outcomes."

American Diabetes Association: Diabetes Care 2012. http://professional.diabetes.org/. Accessed August 2012

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Patient Self Management

- Diet
- Exercise
- Weight Loss
- Medications
- Life Style Changes
- Blood Glucose Monitoring
- ***Education!!***

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General Treatment Goals

- Eliminate symptoms
- Avoid hypoglycemia
- Achieve/maintain ideal body weight
- Normalize growth and development
- Prevent long-term complications
- Obtain glycemic goals

American Diabetes Association: Diabetes Care 2012. http://professional.diabetes.org/. Accessed August 2012

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Glycemic Goals of Therapy

Goal	ADA	AACE
A1c%	< 7%	≤ 6.5%
Premeal Plasma glucose (mg/dL)	70-130	< 110
Post-prandial plasma glucose (mg/dL)	<180	<140

Nathan DM, et al. Diabetes Care. 2006;29:1963-72. American Association of Clinical Endocrinologists. EndocrPract. 2007;13 (suppl1):3-68.

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Recommended Glycemic Goals

- ***More*** intensive:
  - Expected shorter duration of diabetes
  - Long life expectancy
- ***Less*** intensive
  - Greater risk of hypoglycemia
  - Longer duration of diabetes
  - Shorter life expectancy
- In frail, older adults:
  - American Geriatrics Society A1C < 8%
  - Veterans Affairs and Department of Defense A1C 8-9%
  - American Diabetes Association "less stringent glycemic goals"

Brown AF et al. J Am GeriatrSoc. 2003;51(Suppl):S265-S280. American Diabetes Association. Diabetes Care. 2007;30(suppl 1):S4-S41.

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A1c% Correlation

- A1c% and Average Blood Glucose
  - 6.0% = 126 mg/dL
  - 7.0% = 154 mg/dL
  - 8.0% = 183 mg/dL
  - 9.0% = 212 mg/dL
  - 10.0% = 240 mg/dL
  - 11.0% = 269 mg/dL
  - 12.0% = 298 mg/dL

Nathan DM et al. Diabetes Care. 2006;29:1963-72.

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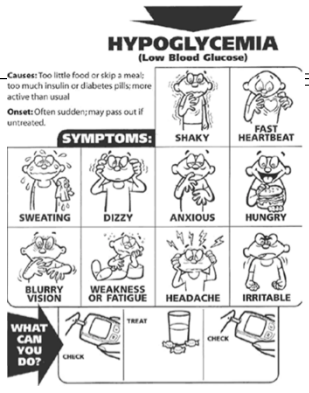

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Hypoglycemia

- Treatment: ***15 grams*** of carbohydrates
  - 4 oz (1/2 cup) of juice or regular soda
  - 2 tablespoons of raisins
  - 4 or 5 saltine crackers
  - 4 teaspoons of sugar
  - 1 tablespoon of honey or corn syrup
  - Glucose tablets

American Diabetes Association: Diabetes Basics. http://www.diabetes.org/diabetes-basics/. Accessed August 2012

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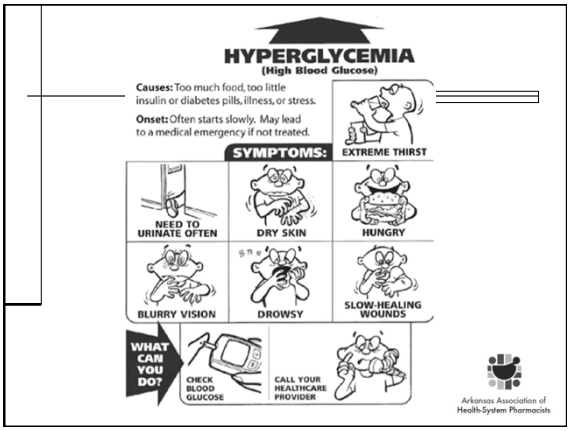

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Severe Hyperglycemia

- Similar Symptoms, Plus:
  - Nausea
  - Stomach cramps
  - Fruity breath
  - Ketones in urine
  - Weight loss
  - Heavy breathing
  - Unconsciousness

American Diabetes Association: Diabetes Basics. http://www.diabetes.org/diabetes-basics/. Accessed August 2012

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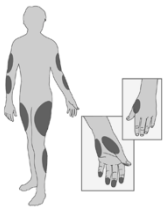
Self-Monitoring Blood Glucose

- Three or more times daily for patients using multiple insulin injections
  - Before breakfast, lunch, and dinner
  - Before bedtime
- Useful guide to therapy
- Different site options for different devices



American Diabetes Association: Diabetes Care 2012. http://professional.diabetes.org/. Accessed August 2012

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LIFESTYLE MANAGEMENT TECHNIQUES

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Healthy Eating

- General Guidelines:
  - Eat at least 3 meals per day
  - Avoid sweets
  - Limit milk to one 8 oz. serving at a time
  - Limit fruit juice
  - Watch fats
  - Make at least half of grains whole grains
  - Fill ½ plate with non-starchy vegetables at each meal

American Diabetes Association: Diabetes Basics. http://www.diabetes.org/diabetes-basics/. Accessed August 2012

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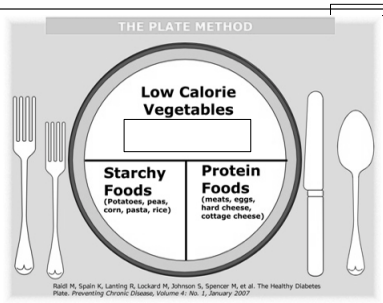
The Plate Method



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Carb Counting

- 1 serving = 15 grams of carbohydrates
- 45-60 grams per meal
- 15 grams per snack
- Serving size!
- Always include protein and fat to balance out meals

American Diabetes Association: Diabetes Basics. http://www.diabetes.org/diabetes-basics/. Accessed August 2012

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Serving Size

- 1 Serving or ***15 grams*** of Carbohydrates:
  - 1 slice of bread
  - 4-6 small crackers
  - 1 cup of low-fat milk
  - 1/4 large baked potato
  - 1 small piece of fruit
  - 1/3 cup pasta or rice (cooked)
  - 1 tablespoon honey

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Medical Nutrition Therapy

- Carbohydrates: 4 kcal/gram, 60-70% of daily calories
  - Sugars, starch, fiber
- Proteins: 4 kcal/gram, 15-20% of daily calories
  - Recommended 1g/kg for adults, 1.2g/kg for kids
- Fat: 9 kcal/gram, 10-20% of daily calories
- Recommendations:
  - Saturated fat < 10%
  - Cholesterol < 300mg
  - Trans minimal

ADA. Standards of Medical Care in Diabetes. Diabetes Care 2012;35(S1):S11-S63

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Limit Alcohol Intake

- Hypoglycemia shortly after drinking and for up to 8-12 hours
- Too much alcohol vs. hypoglycemia: similar symptoms
- Limited amount and with food
- Women ≤ 1 drink/day; Men ≤ 2 drinks/day
- Check blood glucose before drinking and before going to bed

American Diabetes Association: Diabetes Basics. http://www.diabetes.org/diabetes-basics/. Accessed August 2012

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Physical Activity

- Recommended:
  - Daily light activity through normal routine
  - 30 minutes of moderate activity, 5 days per week
    - OR, 25 minutes of vigorous activity, 3 days per week
  - Strength and endurance 3 times weekly

American Diabetes Association: Diabetes Basics. http://www.diabetes.org/diabetes-basics/. Accessed August 2012

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Physical Activity

- Check blood glucose before activity
  - If < 100, may need carbohydrate snack
  - If extremely high, postpone activity
  - If working out for > 30 minutes, check again halfway through
- Always have a fast-acting carbohydrate snack on hand

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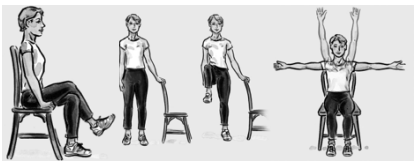
Physical Activity

- Chair exercises
  - Patients with limited mobility due to weight issues and/or comorbidities



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Sick Day Plan

- Check blood glucose every 2-4 hours
- Eat same amount of carbohydrates as usual, or drink fluids with carbohydrates
- Do NOT skip insulin!
- Take oral hypoglycemic medications as usual
- If glucose > 250 mg/dL, drink sugar-free liquids; may need extra regular insulin

American Diabetes Association: Diabetes Care 2012. http://professional.diabetes.org/. Accessed August 2012

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COMPLICATIONS

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Microvascular Complications

- Nephropathy
  - Prevented by both *blood pressure* and *blood glucose* control
  - BP goal < 130/80
  - ACEI or ARB unless contraindicated
  - Micro- & macroalbuminuria
  - Encourage patients to ask their physician how their kidneys are

American Diabetes Association: Diabetes Care 2012. http://professional.diabetes.org/. Accessed August 2012

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Microvascular Complications

- Retinopathy (Cataracts, Glaucoma)
  - Prevent through *blood pressure* and *blood glucose* control
  - Leading cause of new cases of blindness among adults age 20 – 74
  - Yearly dilated eye exam
  - Early detection critical

American Diabetes Association: Diabetes Care 2012. http://professional.diabetes.org/. Accessed August 2012

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Microvascular Complications

- Neuropathy
  - Prevent primarily through *blood glucose* control
  - Possible symptoms of nerve damage:
    - Numbness, tingling, pain in extremities
    - Diarrhea or constipation
    - Problems with urination
    - Erectile dysfunction/vaginal dryness
  - Annual foot exam from provider
  - Amputations!

American Diabetes Association: Diabetes Care 2012. http://professional.diabetes.org/. Accessed August 2012

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Diabetic Foot Care

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Macrovascular Complications

- Cardiovascular complications
  - Higher risk of heart disease and stroke
  - Keep blood pressure and cholesterol at goal
    - BP < 130/80
    - LDL < 100, HDL > 40 (men), HDL > 50 (women), TG < 150
  - Smoking cessation!

American Diabetes Association: Diabetes Care 2012. http://professional.diabetes.org/. Accessed August 2012

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Immunizations

- Pneumococcal vaccine
  - Once, then again when age > 65
- Influenza vaccine
  - Annually

CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

Centers for Disease Control and Prevention: Summary of Recommendations for Adult Immunizations. http://www.cdc.gov/vaccines/schedules/hcp/adult.html. Accessed August 2012

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MEDICATIONS

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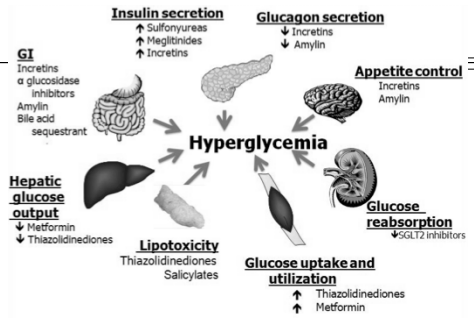

American Diabetes Association: Diabetes Care 2012. http://professional.diabetes.org/. Accessed August 2012

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Counseling Pearls

Medications	Counseling Points
metformin	Take with food; possible diarrhea, dyspepsia
glipizide, glyburide, glimepiride	Take 30 minutes before meals; possible *hypoglycemia*, weight gain, abdominal upset
repaglinide, nateglinide	Take 1-30 minutes before meals; possible *hypoglycemia*, weight gain
acarbose, miglitol	Take with first bite of each meal; possible flatulence, diarrhea
rosiglitazone, pioglitazone	Take WITHOUT regard to meals; possible weight gain, fluid retention
sitagliptin, saxagliptin, linagliptin	Take WITHOUT regard to meals; possible nasopharyngitis, headache, nausea
exenatide, liraglutide	Take up to 60 minutes prior to a meal; possible nausea, vomiting, decreased appetite
pramlintide	Administer immediately prior to meals; possible *hypoglycemia*, nausea, vomiting

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Insulin Counseling Points

- Keep extra supply of insulin in refrigerator
- Keep unrefrigerated insulin away from heat and sunlight
- Never let insulin freeze
- Do not use past expiration date
- Always carry a quick source of sugar with you

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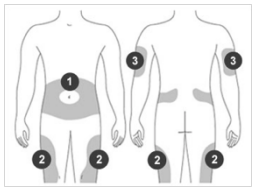
Insulin Injections

- Drawing a dose
- Injection technique
- Injection sites
- Mixing insulin



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Summary

- Disease state management
- Treatment goals
- Lifestyle management
- Complications
- Medications

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Diabetic Foot Infections

Kara Ferguson, PharmD
Pharmacy Practice Resident
UAMS Medical Center

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Objectives

- At the end of this presentation you will be able to:
  - Describe the epidemiology and etiology of a diabetic foot infection (DFI)
  - Classify a DFI
  - Determine initial antibiotic selection
    - And when to modify treatment
  - Recall wound care techniques and dressings

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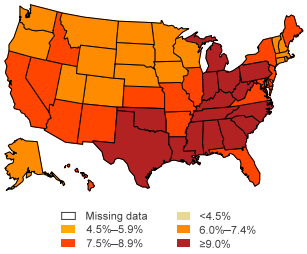
Age–Adjusted Prevalence of Diagnosed Diabetes Among U.S. Adults

2010



CDC's Division of Diabetes Translation. National Diabetes Surveillance System available at http://www.cdc.gov/diabetes/statistics

Epidemiology

- DFI are among the most common complications among diabetics
  - 20% account for diabetic hospitalizations
- Annual cost $200-$350 million/year
- 25% of diabetic patients experience a soft-tissue infection during their lifetime

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Epidemiology Continued

- 55,000 lower-extremity amputations per year
  - 50% of all non-traumatic amputations in US
- 10-20% of diabetics will undergo additional surgery or amputations within 12 months
  - Increases to 25-50% by 5 years
  - Death reported in as much as 2/3 of patients

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Etiology

- Three major types of foot infections
  - Deep abscesses
  - Cellulitis of the dorsum
  - Mal perforans ulcers
- DFI begin with local bacterial invasion
  - Typically polymicrobial
  - Average of 2.3-5.8 isolates/culture
- MRSA reported in up to 30% of DFI

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Etiology Continued

Gram-Positive Organisms	Percentage of Isolates
Staphylococcus aureus	15-20%
Streptococcus spp	6-12%
Enterococcus spp	7-20%
Coagulase negative staph	6-10%
Other	0-12%

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Image: http://www.microbeworld.org/index.php?option=com_jlibrary&view=article&id=7611

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Etiology Continued

Gram-Negative Organisms	Percentage of Isolates
Proteus spp	5-6%
Enterobacter spp	1-2%
Escherichia spp	3-5%
Klebsiella spp	1-2%
Pseudomonas aeruginosa	1-3%
Other	3-8%

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Image: http://www.microbeworld.org/index.php?option=com_jlibrary&view=article&id=7794

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Etiology Continued

Organisms	Percentage of Isolates
Peptostreptococcus spp	8-12%
Bacteroides fragilis	4-7%
Other *Bacteroides* spp	3-6%
Clostridium spp	0-2%
Other Anaerobes	7-10%

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Pathophysiology

- Three key factors for DFI
  - Neuropathy
    - Absence of pain
    - Unable to feel minor injuries
  - Angiopathy and ischemia
    - Anhidrosis
    - Peripheral vascular disease (PVD)
  - Immunologic defects
    - Impaired phagocytosis
    - Impaired intracellular microbicidal function

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Clinical Presentation

- Infections are much more extensive than they appear
- PVD patients seek care for swelling
- Lesions vary in size and clinical features
  - Erythema
  - Edema
  - Warmth
  - Presence of pus
  - Draining of sinuses
  - Pain
  - Tenderness
  - Foul-smelling odor

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Classifying Foot Ulcers

- First step is to classify the wound
- Classification based on
  - Clinical evaluation
  - Extent of the lesion
  - Assessment of vascular status of the foot
- Wagner classification
  - Grade 0 through 5

O'Neal, LW, Wagner, FW. The Diabetic Foot, Mosby, St Louis 1983. p.274.

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Wagner Scale: Grade 0

- High risk foot
- No ulcer
- Counseling points
  - Avoid poor fitting shoes
  - No walking barefoot
  - Smoking cessation

O'Neal, LW, Wagner, FW. The Diabetic Foot, Mosby, St Louis 1983. p.274.

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Wagner Scale: Grade 1

- Superficial ulcer
- Involving full thickness of the skin
  - Does not involve underlying tissues

O'Neal, LW, Wagner, FW. The Diabetic Foot, Mosby, St Louis 1983. p.274.

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Wagner Scale: Grade 2

- Deep ulcer
- Penetrating down to ligaments and muscle
- No bone involvement
- No abscess formation

O'Neal, LW, Wagner, FW. The Diabetic Foot, Mosby, St Louis 1983. p.274.

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Wagner Scale: Grade 3

- Deep ulcer
- Cellulitis or abscess formation
- Often with osteomyelitis

O'Neal, LW, Wagner, FW. The Diabetic Foot, Mosby, St Louis 1983. p.274.

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Wagner Scale: Grade 5

- Gangrene
  - 5: involving whole foot

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Goals of Therapy

- Preservation of limb
- Prevent additional infections
- Prevent complications
- Comprehensive treatment
  - Wound care
  - Antibiotics
  - Debridement
  - Tight glycemic control

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IDSA GUIDELINES

2012 Infectious Diseases Society of America Clinical Practice Guideline for the Diagnosis and Treatment of Diabetic Foot Infections[a]

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When to suspect infection?

- Evidence of infection
- Risk factors present
  - Probe-to-bone (PTB) test positive
  - Ulceration for > 30 days
  - Traumatic food wound
  - Peripheral vascular disease
  - Previous lower limb amputation
  - Renal insufficiency

Lipsky BA. Clin Infect Dis. 2012;54(12):e132.

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Classification of DFI: IDSA 2004

- Uninfected
  - Wound lacking purulence
  - No manifestations of inflammation
- Mild
  - ≥2 manifestations of inflammation
  - Cellulitis/erythema extends ≤ 2cm around ulcer
  - Limited to skin or superficial subcutaneous tissue
  - No other local complications or systemic illness

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Classification of DFI: IDSA 2004

- Moderate
  - Same criteria as mild and metabolically stable
  - >1 of the following characteristics
    - Cellulitis extending >2 cm
    - Lymphangitic streaking
    - Spread beneath superficial fascia
    - Deep-tissue abscess
    - Gangrene
    - Involvement of muscle, tendon or joint

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Classification of DFI: IDSA 2004

- Severe
  - Systemic toxicity or metabolic instability
    - Fever
    - Chills
    - Tachycardia
    - Hypotension
    - Confusion
    - Vomiting
    - Acidosis
    - Severe hyperglycemia
    - Azotemia

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DFI: Who gets hospitalized?

- Patients with severe infections
- Select moderate infections with complications
  - Peripheral arterial disease
  - Lack of home support
  - Poor compliance
- Patients who fail to improve

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Hospitalized: When to discharge?

- Clinically stable
- Acceptable glycemic control
- Had surgery performed (if needed)
- Able to manage care at discharge location
- Well defined plan
  - Appropriate antibiotic regimen
  - An off-loading scheme (if needed)
  - Wound care instructions
  - Outpatient follow-up

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Obtaining Specimen for Culture

- Uninfected = NO CULTURE
- Infected wounds
  - Culture prior to antibiotics, if possible
  - Culture should be from deep tissue
    - After the wound has been cleansed and debrided
  - Avoid swab specimens
    - Especially of inadequately debrided wounds
    - Provide less accurate results

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Initial Antibiotic Selection

- Uninfected wounds = NO treatment
- Infected wounds = antibiotic therapy
  - Often insufficient without proper wound care

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Empiric Antibiotics

- Mild to moderate infections
  - Target aerobic, Gram + cocci
- Severe infections
  - Broad spectrum
- *Pseudomonas* coverage
  - Usually unnecessary
- MRSA
  - Coverage important in patient with prior history
  - High local prevalence of MRSA
  - Clinically severe infection

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Definitive Therapy

- Culture results
- Sensitivities
- Patients clinical response to empiric therapy

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Duration of Antibiotics

- Soft tissue infections
  - Mild
    - 1 to 2 weeks
  - Moderate to severe
    - 2 to 3 weeks

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Antibiotic Choices: Mild Infection

Probable Pathogens

- *Staphylococcus aureus* (MSSA)
- *Streptococcus* spp

Antibiotics

- Dicloxacillin
- Clindamycin
- Cephalexin
- Levofloxacin
- Amoxicillin-clavulanate

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Antibiotic Choices: Mild Infection

Probable Pathogen

- MRSA

Antibiotics

- Doxycyline
- Trimethoprim + sulfamethoxazole

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Antibiotic Choices: Moderate/Severe

Probable Pathogens
- MSSA
- *Streptococcus* spp
- *Enterobacteriaceae*
- Obligate anaerobes

Antibiotics
- Levofloxacin
- Cefoxitin
- Ampicillin-sulbactam
- Moxifloxacin
- Ertapenem
- Tigecycline
- Levofloxacin or ciprofloxacin
  - With clindamycin
- Imipenem-cilastatin

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Antibiotic Choices: Moderate/Severe

Probable Pathogen
- MRSA

Antibiotics
- Linezolid
- Daptomycin
- Vancomycin

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Antibiotic Choices: Moderate/Severe

Probable Pathogen
- *Pseudomonas aeruginosa*

Antibiotic
- Piperacillin-tazobactam

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Antibiotic Choices: Moderate/Severe

Probable Pathogens
- MRSA
- *Enterobacteriaceae*
- *Pseudomonas*
- Obligate anaerobes

Antibiotics
- Vancomycin
- Ceftazidime
- Cefepime
- Piperacillin-tazobactam
- Aztreonam
- Carbapenem

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Imaging: When is it appropriate?

- Plain radiographs should be performed
  - In all patients presenting with a new DFI
  - Looking for
    - Deformities
    - Destruction
    - Soft tissue gas
    - Foreign bodies

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Imaging Continued

- MRI
  - More sensitive and specific
  - Used when soft tissue abscess suspected
  - Appropriate if osteomyelitis uncertain
- If MRI is contraindicated
  - Radionucleotide bone scan
  - Labeled white blood cell scan

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Osteomyelitis

- Considered as a potential complication
  - Infected DFI
  - Deep ulcer
  - Large ulcer
    - Especially when it overlies a bony prominence

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Diabetic Foot Osteomyelitis (DFO)

- PTB test with any open DFI
- MRI for diagnostic imaging
- Most definitive way to diagnose
  - Bone culture
  - Histology

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Diabetic Foot Osteomyelitis

- Adjunctive treatment **not** supported
  - Hyperbaric oxygen therapy
  - Growth factors
  - Maggots
  - Topical negative pressure therapy
    - Vacuum-assisted closure

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DFI: Surgical Intervention

- Recommend urgent intervention
  - DFI accompanied by gas in deeper tissue
  - Abscess
  - Necrotizing fasciitis
- Less urgent
  - Substantial nonviable involvement
    - Tissue
    - Bone
    - Joint

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DFI: Wound Care Techniques

- Debridement
  - Aimed at removing
    - Debris
    - Eschar
    - Surrounding callous
  - Sharp methods are generally best
  - Mechanical, autolytic or larval appropriate in some DFI

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DFI: Wound Care Techniques

- Redistribution
  - Pressure off the wound
  - Particularly important in plantar wounds
  - Also necessary to relieve pressure of
    - Dressings
    - Footwear
    - Ambulation

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DFI: Wound Care Techniques

- Selection of Dressing
  - Allow for moist wound healing
  - Control excess exudation
  - Based on
    - Size
    - Depth
    - Nature of ulcer
      - Dry vs purulent

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Pharmacist Role

- Counseling Points
  - Proper fitting shoes
  - Avoid walking barefoot
  - Smoking cessation
- Foot exams
- Appropriate antibiotics
  - Drug, dose, and route
    - Vancomycin

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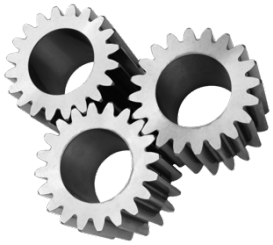
?? QUESTIONS ??



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