

DIABETES MELLITUS

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TYPES OF DM

- TYPE I DM (IMMUNE MEDIATED VS IDIOPATHIC)
- TYPE II DM
- GESTATIONAL DIABETES
- DM is not limited to just these classifications

- LEADING CAUSE OF:
ADULT BLINDNESS
END-STAGE KIDNEY DISEASE
NON-TRAUMATIC AMPUTATIONS
- MAJOR CONTRIBUTING FACTORS TO:
HEART DISEASE
STROKE
HYPERTENSION

ETIOLOGY AND PATHO

- COMBINATION OF CAUSATIVE FACTORS
 1. GENETIC/HEREDITARY
 2. AUTOIMMUNE
 3. ENVIRONMENTAL (INFECTION, TOXINS)
 4. LIFESTYLE
- ABSENT OR INSUFFICIENT INSULIN AND/OR POOR UTILIZATION OF INSULIN

PATHOPHYSIOLOGY

- INSULIN: RELEASED FROM THE BETA CELLS OF PANCREAS TO LOWER GLUCOSE LEVELS
- GLUCAGON: RELEASED FROM THE ALPHA CELLS OF THE PANCREAS

Actions of Insulin

- Carbohydrate (CHO) metabolism
 - Facilitate glucose transport into cell to bring down blood glucose level
 - Stimulate liver - storage of glucose
- Lipid metabolism
 - Glucose entry into lipid cells
 - Inhibit breakdown of fat in adipose tissue
- Protein Utilization
 - Amino acids to form proteins
- Other
 - Increase permeability of cells to K , Mg, and phosphate ions.

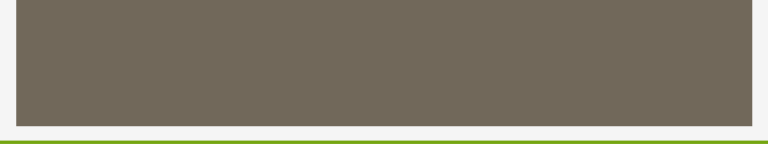
PATHO OF INSULIN

- Counter regulatory hormones
 - Glucagon, epinephrine, growth hormone, cortisol
 - Oppose effects of insulin
 - Stimulate glucose production and release by the liver
 - Decrease movement of glucose into cell
 - Help maintain normal blood glucose levels

Gestational Diabetes

- ❖ Develops during pregnancy
- ❖ Usually glucose levels normal 6 weeks post partum
- ❖ Baby weighs > 9 lb. at birth
- ❖ 35% to 60% chance of developing T2DM within 10 years.





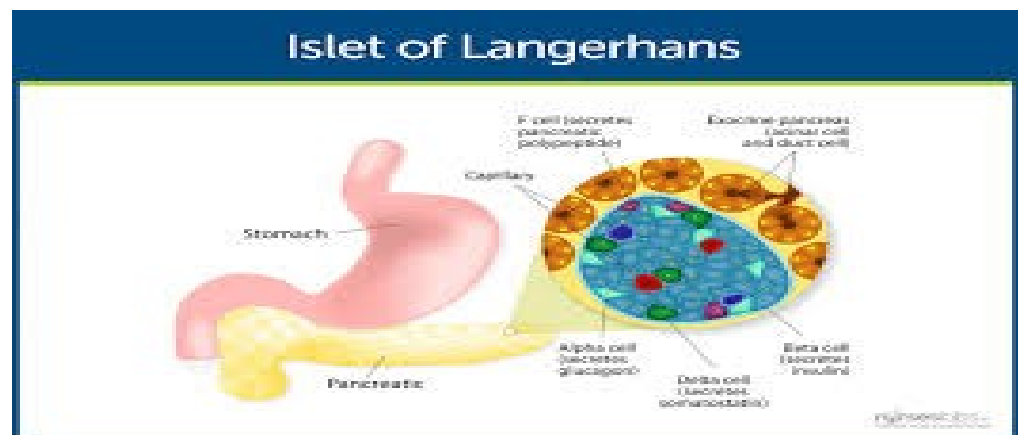
TYPE 1 DIABETES MELLITUS (T1DM)

TYPE 1 DIABETES MELLITUS (T1DM)

- FORMERLY KNOWN AS JUVENILE-ONSET DIABETES OR INSULIN DEPENDENT DIABETES
- ACCOUNTS FOR 5-10% OF POPULATION
- 40% DEVELOP IT BEFORE THE AGE OF 20
- GENERALLY AFFECTS PEOPLE YOUNGER THAN 40
- INCIDENCE HAS INCREASED 3-5% OVER RECENT DECADES

PATHO OF T1DM

- COMPLETE DESTRUCTION OF THE PANCREATIC CELLS
- PROGRESSES TO LACK OF INSULIN PRODUCTION



RISK FACTORS

- AUTOIMMUNE
- VIRAL
- ENVIRONMENTAL
- MEDICALLY INDUCED: EX: REMOVAL OF PANCREAS

DIABETES MELLITUS - TYPE 1

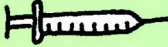
SIGNS & SYMPTOMS:

Polyuria
↑ Urination

Polydipsia
↑ Thirst

Polyphagia
↑ Hunger



- Weight Loss
- Fatigue
- ↑ Frequency of Infections
- Rapid Onset
- Insulin  Dependent
- Familial Tendency
- Peak Incidence From 10 to 15 Years

DIAGNOSIS

- ◉ HEMOGLOBIN A1C (HGB A1C)
- ◉ FASTING BLOOD GLUCOSE
- ◉ 2 HR POSTPRANDIAL OR ORAL GLUCOSE TOLERANCE TEST (OGTT)
- ◉ RANDOM BLOOD GLUCOSE

HGB-A1C

- MEASURES THE AVERAGE BG LEVELS OVER THE PRIOR 2-3 MONTHS
- DOES NOT GIVE CHANGES IN ACUTE OR HOUR-TO-HOUR CHANGES
- REPORTED AS THE PERCENTAGE OF TOTAL BLOOD
- RESULTS AFFECTED BY PREGNANCY, CKD, THALASSEMIA, Fe DEF ANEMIA, PERNICIOUS ANEMIA, RECENT ACUTE BLOOD LOSS OR TRANSFUSION

Correlation of A1C with Average Glucose

% A1C	Level of Control	Average Blood Glucose Levels
		mg/dL
12.0	IMMEDIATE ACTION SUGGESTED	345
11.5		
11.0		310
10.5		
10.0	ACTION SUGGESTED	275
9.5		
9.0		240
8.5		
8.0	MONITOR CLOSELY	205
7.5		
7.0	ADA GOAL*	170
6.5		
6.0	NORMAL	135

FASTING BLOOD GLUCOSE

- NO CALORIC INTAKE FOR AT LEAST 8 HOURS
- 70-110 mg/dL normal range
- GREATER THAN OR EQUAL TO 126 mg/dL is considered a positive DM



2-HR POSTPRANDIAL ORAL GLUCOSE TOLERANCE TEST (OGTT)

- PATIENT CONSUMES BEVERAGE WITH GLUCOSE LOAD (75g CHO) AFTER FASTING 8-12 HOURS
- BLOOD SAMPLE TAKEN PRIOR TO CONSUMPTION THEN AGAIN 1 hr AND 2 hrs AFTER CONSUMPTION
- VALUE BASED ON LEVEL AT THE 2 hr MARK
- IF >200 OR $=$ TO 200 mg/dL is positive for DM

RANDOM BLOOD GLUCOSE

- A RANDOM BG LEVEL OF ≥ 200 mg/dL
- MUST HAVE SYMPTOMS OF HYPERGLYCEMIA OR HYPERGLYCEMIC CRISIS TO BE CLASSIFIED AS DM

SELF-BLOOD GLUCOSE MONITORING

- VIA FINGER STICK MOST COMMON
- PROVIDES TIMELY FEEDBACK TO THE PATIENT
- MOST COMMON ERROR IS BLOOD SAMPLE SIZE
- ADVISED BEFORE EACH MEAL AND AT BEDTIME



CONTINUOUS GLUCOSE MONITORING(CGM)

- TINY SENSOR UNDER THE SKIN
- SENDS INFO VIA RADIO WAVES TO MONITOR
- PROVIDES REAL-TIME MEASUREMENTS OF BG LEVELS
- GOOD FOR THOSE PATIENTS WITH ERRATIC AND UNPREDICTABLE DROPS
- WARNS OF DANGEROUS LEVELS

Insulin Pump Therapy

- ❖ Continuous subcutaneous insulin infusion (CSII) via external device worn somewhere on the body
- ❖ Provides a continuous infusion of “basal” insulin
- ❖ Patient “boluses” for meal at time of meal
- ❖ Bolus determined by pre-meal BS and CHO content of meal
- ❖ Never uses long or intermediate acting insulin

Pump Therapy Is NOT

- ❖ Pump does not regulate blood glucose automatically
- ❖ Does not decrease need to check BS
- ❖ Does not replace the regulatory system of the normal functioning pancreas
- ❖ Not easy or inexpensive
- ❖ Not complication free



Pump Therapy Indicators

- ❖ HbA1C > 6.5%
- ❖ Frequent hypoglycemia
- ❖ Shift work
- ❖ Type 2 w/ gastroparesis
- ❖ Dawn phenomenon
- ❖ Pediatrics
- ❖ Exercise
- ❖ Hectic lifestyle



Pump Candidates

❖ Motivated to

- Be active participant in management
- Quantify food intake
- Monitor BG

❖ Adequate vision & fine motor skills

❖ Strong support system

❖ Insurance coverage



Insulin Pump Therapy

Benefits

- ❖ Improved glycemic control
- ❖ Better pharmacokinetic delivery of insulin
- ❖ Increased flexibility
- ❖ Variable & individualized basal rates
- ❖ Does NOT eliminate SMBG

Risks

- ❖ Hypoglycemia
- ❖ Hyperglycemia
- ❖ Infusion site problems
- ❖ Takes time & commitment
- ❖ Proper planning
- ❖ Cost

Nursing Consideration – Insulin Pumps

- ❖ **Pumps cannot be worn to MRI or CT**
- ❖ **Ensure all members of health care team aware patient is wearing pump**
- ❖ **If problems occur**
 - **Contact HCP who manages pump**
 - **24 hr 800 number on back of pumps for tech support**

INSULIN

- EXOGENOUS INSULIN
 - INSULIN FROM OUTSIDE SOURCE
 - REQUIRED FOR T1DM
 - PRESCRIBED FOR PATIENTS WITH T2DM WHO CANNOT MANAGE BLOOD GLUCOSE LEVELS BY OTHER MEANS



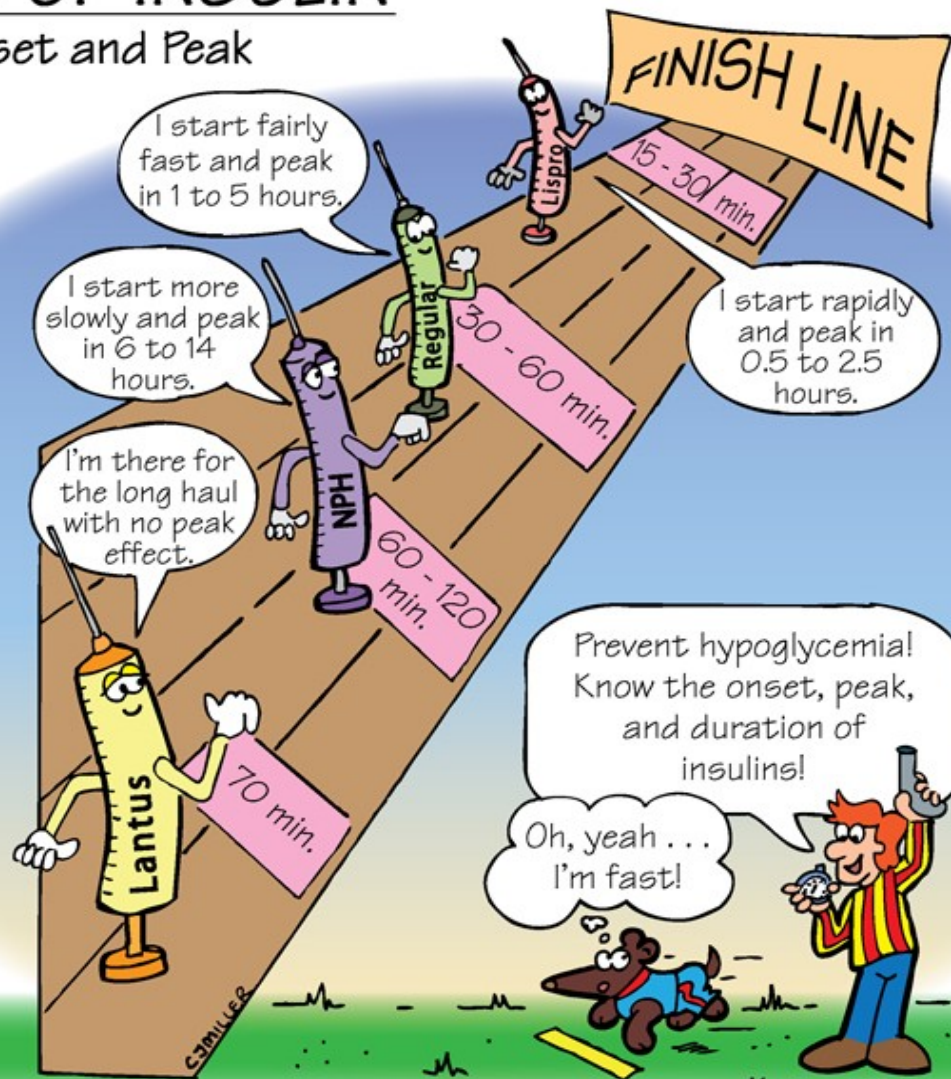
TREATMENT--INSULIN

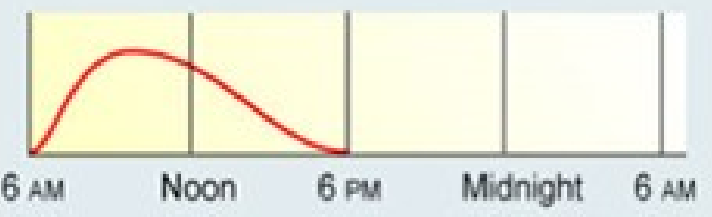
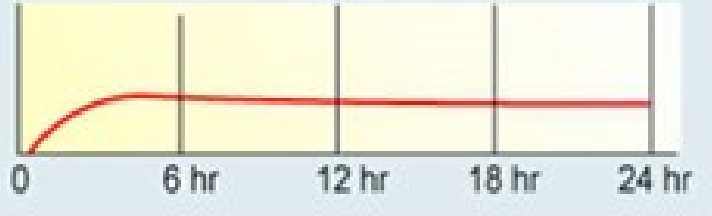
- HUMAN INSULIN—IDENTICAL TO INSULIN PRODUCED BY THE PANCREAS
- HUMAN INSULIN ANALOGS- MODIFIED FORMS OF HUMAN INSULIN



TYPES OF INSULIN

Onset and Peak



INSULIN PREPARATION	ONSET, PEAK, DURATION	EXAMPLE
Rapid acting lispro (Humalog) aspart (NovoLog) glulisine (Apidra)	Onset: 10–30 min Peak: 30 min–3 hr Duration: 3–5 hr 	
Short acting Regular (Humulin R, Novolin R)	Onset: 30 min–1 hr Peak: 2–5 hr Duration: 5–8 hr 	
Intermediate acting NPH (Humulin N, Novolin N)	Onset: 1.5–4 hr Peak: 4–12 hr Duration: 12–18 hr 	
Long acting glargine (Lantus) detemir (Levemir)	Onset: 0.8–4 hr Peak: no pronounced peak Duration: 24+ hr 	

RAPID ACTING INSULIN

- ADMINISTERED WITH MEALS
- Onset 10-30min, Peaks 30min -3hours, Duration 3-5 hours
- **INSULIN LISPRO (HUMALOG)**
- **INSULIN ASPART (NOVOLOG)**
- **INSULIN GLULISINE (APIDRA)**
- **INHALED HUMAN INSULIN (AFREZZA)**

SLOWER ACTING INSULIN

- CAN BE GIVEN SQ, IM, OR IV
- FOR ROUTINE TREATMENT TO CONTROL POSTPRANDIAL HYPERGLYCEMIA AND BASAL GLYCEMIC CONTROL
- **REGULAR INSULIN (HUMULIN R, NOVOLIN R)**
- USED IN SLIDING SCALE COVERAGE
- ONSET 30-60 MIN; PEAK 2-5 HR; DURATION 5-8 HR

RAPID ACTING INSULIN

Warning: Due to its rapid onset, have food ready or ingested when using Humalog or Humulin R.

Only NPH insulin can be mixed with short-acting insulin (regular), and the 3 rapid-acting insulins (lispro, aspart, glulisine).

All 3 rapid-acting insulins (lispro, aspart, glulisine), and regular (Humulin R) can be given IV.

Rapid-acting insulins can be administered (often using a sliding scale) according to blood glucose levels (SMBG*) and adjusted to calorie intake.

*Self-monitored blood glucose.

1st Place

Fastest Rapid Acting

Lispro (Humalog)

Starts 15 min
peaks 0.5-2.5 hr
duration 3-6 hrs
SubQ

2nd Place

Regular (Humulin R)

Starts 0.5-1 hr
peaks 1-5 hrs
duration 6-10 hrs
SubQ

INTERMEDIATE

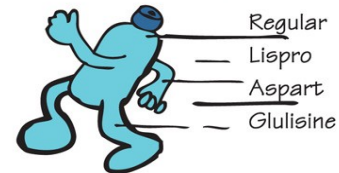
- **NPH INSULIN (HUMULIN, NOVOLIN N)**
- ONSET 1.5-4 hours; PEAK 4-12 HOURS; DURATION 12-18 HOURS



MIXING INSULIN:

Draw Up The Clear...

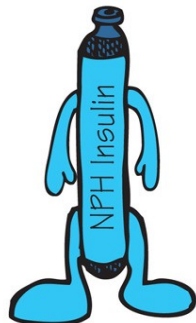
(Clear and Short-Acting)



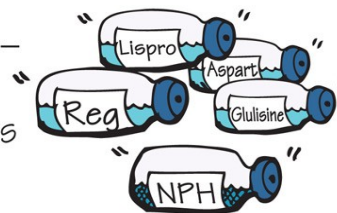
Before The Cloudy...

(NPH Cloudy and Intermediate-Acting)

Only Longer Acting You Can Mix!



Only the short-acting preparations—regular, lispro, aspart, and glulisine insulin—can be mixed with other insulins (usually NPH insulin).



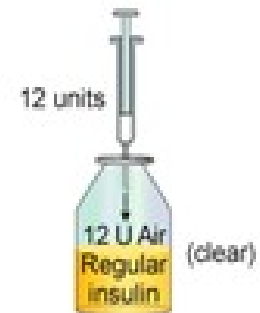
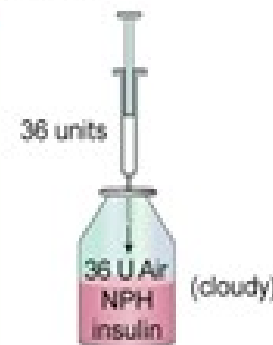
Note: All insulins available today are clear, except NPH.

Mixing Insulins

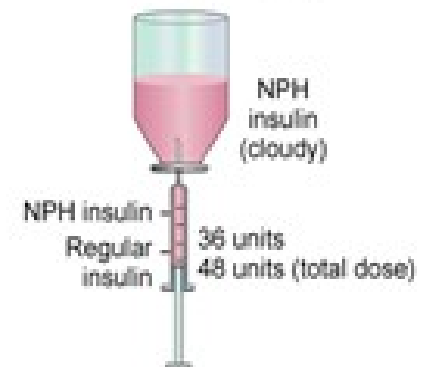
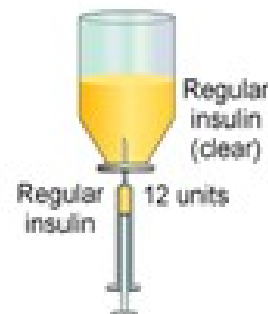
Fastest acting **F**irst

Longer acting **L**ast

- 1 Wash hands.
- 2 Gently rotate NPH insulin bottle.
- 3 Wipe off tops of insulin vials with alcohol sponge.
- 4 Draw back amount of air into the syringe that equals total dose.
- 5 Inject air equal to NPH dose into NPH vial. Remove syringe from vial.
- 6 Inject air equal to regular dose into regular vial.



- 7 Invert regular insulin bottle and withdraw regular insulin dose.
- 8 Without adding more air to NPH vial, carefully withdraw NPH dose and add to regular insulin already in syringe.



LONG DURATION

- **INSULIN GLARGINE (U-100)**
(*LANTUS*)
- **INSULIN DETEMIR (*LEVEMIR*)**
- DOSING CAN BE DONE ANY TIME OF THE DAY BUT SAME TIME EVERYDAY
- Onset: 1-4 hours, No Peak, Duration 24+ hours

LONGER DURATION

- ◉ **INSULIN GLARGINE U-300 (TOUJEO):**
- ◉ **INSULIN DEGLUDEC (TRESIBA):**
- ◉ ONCE DAILY
- ◉ DOSED IN PRE-FILLED PENS
- ◉ Duration: >24 hours

Insulin Appearance

- ❖ Insulins made in the U.S. are *clear, colorless solutions*, except for NPH insulins
- ❖ NPH insulin is a *cloudy suspension*
- ❖ Inspect insulin before using & should discard if the insulin looks abnormal
- ❖ Concentration
 - 100 units/mL (U-100)
 - 500 units/mL (U-500)



Insulin Administration

- ❖ **Given only by injection - subQ, IM**
- ❖ **IV use – Regular only in ICU**
- ❖ **Gently mix suspension prior to drawing up**
- ❖ **Store unopened vials in the refrigerator**
- ❖ **Opened vials can remain at room temperature for one month**
- ❖ **Label vials with date & time opened**

Premixed Insulin

- ❖ NPH + Rapid acting analog OR Regular insulin
- ❖ A variety of mixtures 70:30 (70% NPH & 30% regular or analog)
- ❖ Cloudy appearance
- ❖ Pro: easier for patient
- ❖ Con: NPH unpredictable, risk for high/low BG



Insulin Pens

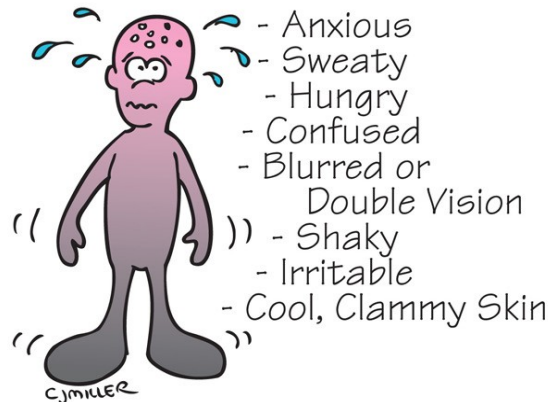
❖ Pre-filled pens

- Hold 300 U of insulin
- Disposable needle is attached to pen
- Dial dose of insulin in increments of 1 or 2 units
- Convenient when traveling
- Good for only 28 days
- Useful – impaired manual dexterity, vision or cognitive function.

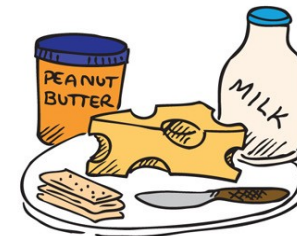
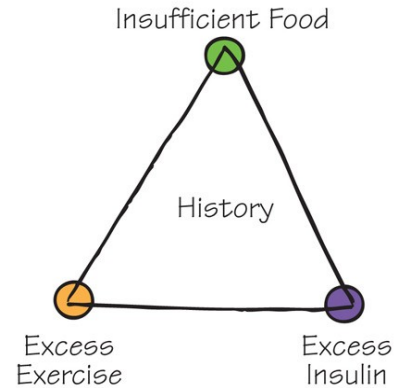




Onset
Rapid...
1 - 3 Hours



HYPOGLYCEMIA



Needs...
BLOOD SUGAR ↑

Increased > 70mg/dL

HYPOGLYCEMIA UNAWARENESS

- WHEN HYPOGLYCEMIA OCCURS FREQUENTLY
- THE BODY CAN LOSE THE EARLY WARNING SIGNALS OF THE SYMPATHETIC NERVOUS SYSTEM
- PATIENTS SKIP THE FIRST WARNING SIGNS
- RISK FOR NEUROLOGICAL SYMPTOMS SUCH AS CONFUSION OR LOC

TREATMENT

- ADMINISTER GLUCOSE
JUICE, SODA, BREAD OR CRACKERS
- CHECK FINGERSTICK 15 MIN AFTER
ADMIN OF GLUCOSE
- IF LEVEL STILL LOW, REPEAT GLUCOSE
- AFTER REACH NORMAL-EAT MEAL OR
SNACK

- IN HOSPITAL SETTING OR PATIENT UNABLE TO SWALLOW:
 - IV DEXTROSE 25-50ML OF D50
 - NO IV ACCESS: 1MG IM GLUCAGON INJECTION TO RELEASE GLUCOSE STORED IN THE LIVER

GLUCAGON

“Glucagon, When the Sugar’s Gone!”

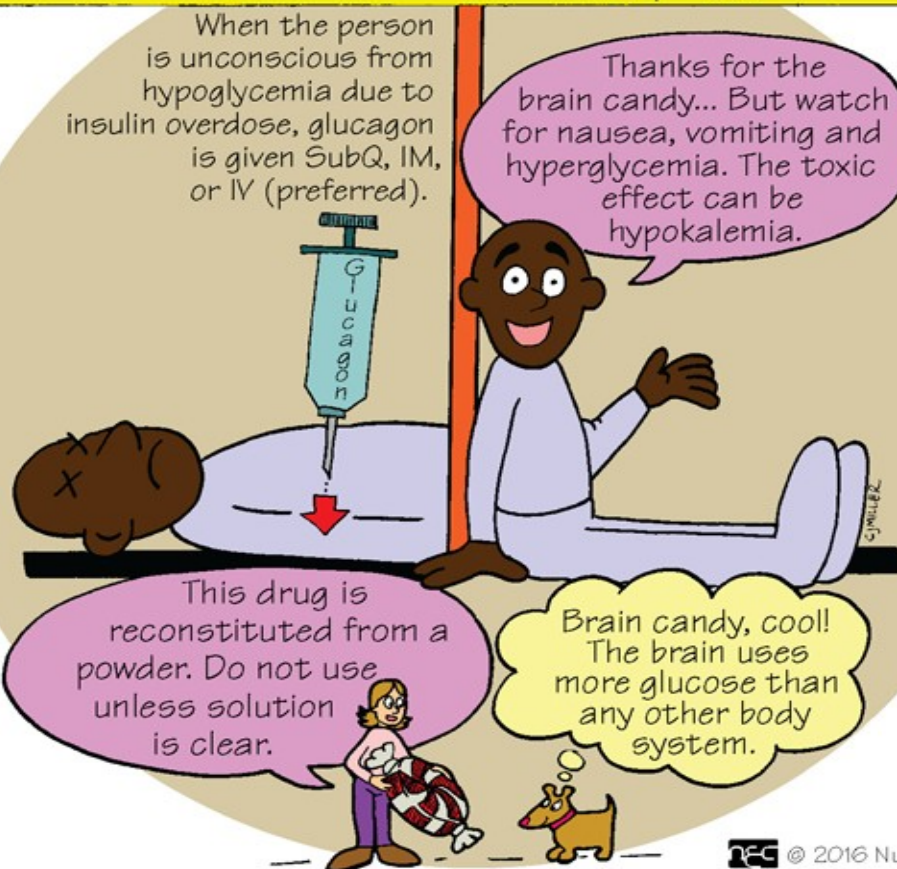
A first aid kit for severe hypoglycemia

When the person is unconscious from hypoglycemia due to insulin overdose, glucagon is given SubQ, IM, or IV (preferred).

Thanks for the brain candy... But watch for nausea, vomiting and hyperglycemia. The toxic effect can be hypokalemia.

This drug is reconstituted from a powder. Do not use unless solution is clear.

Brain candy, cool!
The brain uses more glucose than any other body system.



TYPE 2 DIABETES MELLITUS

TYPE 2 DIABETES MELLITUS (T2DM)

- MORE COMMON IN ADULTS
- ACCOUNTS FOR 90-95% OF ALL DM CASES
- PRESENT IN ALL ETHNIC GROUPS BUT MORE PREVALENT IN NON-WHITES
- SLOWER ONSET THAN T1DM
- INSULIN IS PRESENT BUT CELLS RESIST
- OVER TIME PANCREAS CANNOT KEEP UP WITH THE DEMAND

Leading to T2DM

- INSULIN RESISTANCE
- PRE-DIABETES
- METABOLIC SYNDROME

MODIFIABLE RISK FACTORS

- BMI ≥ 26 AND RISK INCREASES >30
- PHYSICAL INACTIVITY
- HDL ≤ 35 MG/dL &/or TG ≥ 250 mg/DL
- METABOLIC SYNDROME

NON-MODIFIABLE RISK FACTORS

- FIRST-DEGREE RELATIVE WITH DM
- MEMBERS OF HIGH RISK ETHNIC POPULATION
- WOMEN WHO DELIVERED BABY 9LBS OR GREATER OR WHO HAD GDM
- HTN
- WOMEN WITH POS
- HgbA1C OF 5.7% OR GREATER
- HISTORY OF CVD

TYPE 2 DIABETES

Genetic Mutations = Insulin Resistance
& Familial Tendency

- Polyuria, Nocturia
- Polydipsia
- Polyphagia
- Recurrent Infections
- Prolonged Wound Healing
- Visual Changes
- Fatigue, ↓ Energy
- HbA1c ↑ 6.5%, FPG - ↑ 126mg/dL
- Prediabetes FPG 100-125mg/dL
- Metabolic Syndrome

Metabolic Syndrome -
↑ Risk for Diabetes
• ↑ Triglycerides
• ↓ HDL's
• ↑ B/P
• Central Obesity
• Sedentary Lifestyle
• FPG > 126 mg/dL
• Most Common ↑ 35yrs



Nursing Implementation

❖ Health promotion

- Identify, monitor, & teach patients at risk
- Obesity: primary risk factor T2DM
- Routine screening for all overweight adults & those > 45 yr. old
- Diabetes risk test
 - <http://www.diabetes.org/diabetes-basics/prevention/diabetes-risk-test/>

CLINICAL MANIFESTATIONS

3 P'S—POLYURIA, POLYDIPSIA, POLYPHAGIA

- FATIGUE
- POOR WOUND HEALING
- CARDIOVASCULAR DISEASE (CVD)
- RENAL INSUFFICIENCY
- RECURRING INFECTIONS—BACTERIAL
AND YEAST

MEDICAL MANAGEMENT

- EDUCATION
- MONITORING GLYCEMIC CONTROL
- DIET
- EXERCISE
- MONITORING FOR COMPLICATIONS
- ORAL GLUCOSE CONTROL AGENTS
- INSULIN IF NEEDED

ORAL AGENTS/MEDICATIONS

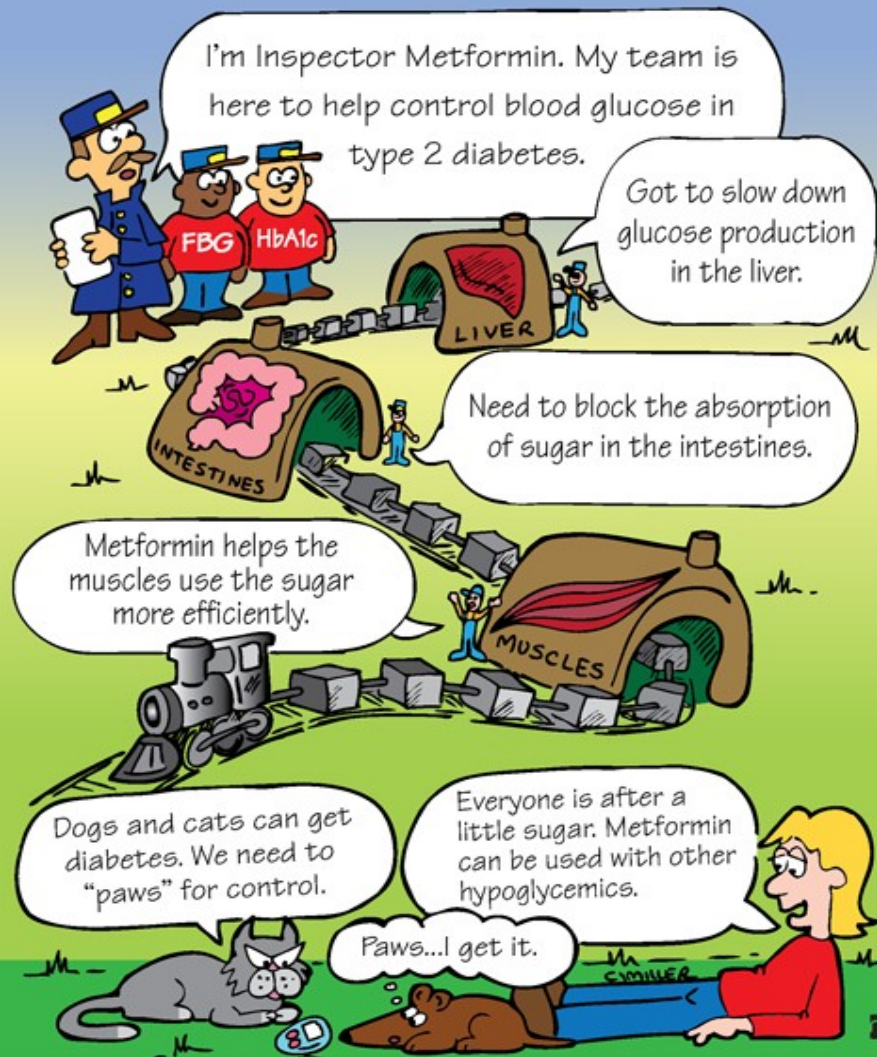
- WORK IN A VARIETY OF WAYS:
 - STIMULATE INSULIN RELEASE FROM BETA CELLS
 - MODULATE THE RISE IN GLUCOSE AFTER A MEAL
 - DELAY CHO DIGESTION/ABSORPTION

METFORMIN (GLUCOPHAGE)

- MOST COMMONLY USED
- STARTED IMMEDIATELY AFTER THE DIAGNOSIS
- SIDE EFFECTS: GI UPSET, AND RARELY LACTIC ACIDOSIS
- LOWERS BG AND IMPROVES GLUCOSE TOLERANCE

METFORMIN

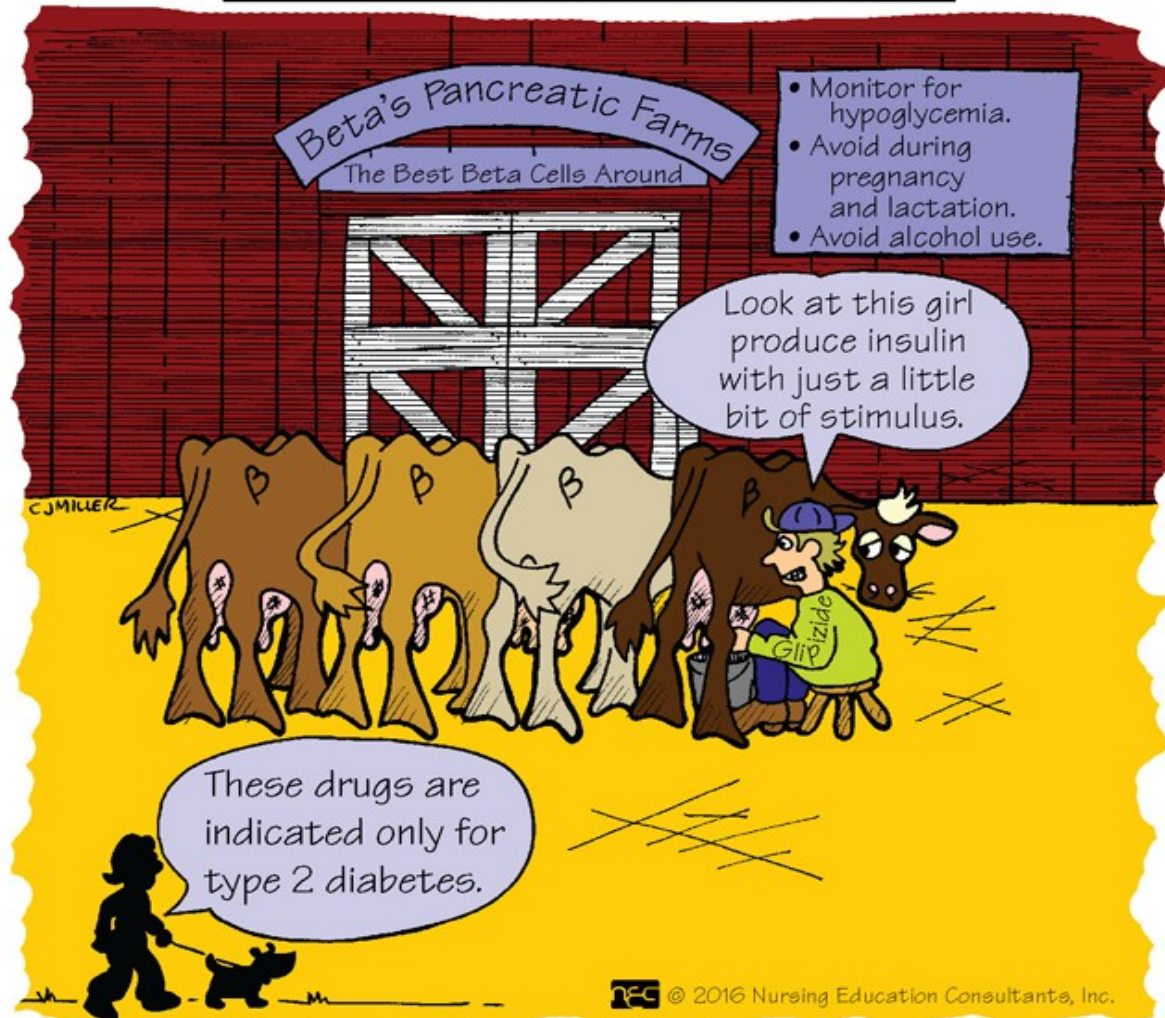
(GLUCOPHAGE)



SULFONYLUREAS

- PROMOTE INSULIN RELEASE
- SIDE EFFECTS: HYPOGLYCEMIA AND WEIGHT GAIN
- SECOND-GENERATION DRUGS MORE COMMONLY USED: **GLIPIZIDE, GLYBURIDE, AND GLIMEPRIDE**
- ALCOHOL USE CAN POTENTIATE HYPOGLYCEMIA EFFECTS (FLUSHING, PALPITATIONS, AND NAUSEA)

SULFONYLUREAS



MEGLITINIDES (GLINIDES)

- STIMULATE INSULIN RELEASE
- SHORT-ACTING AND TAKEN WITH EACH MEAL
- HALF-LIFE IS ONLY 1 HOUR, COMPLETELY ABSORBED/METABOLIZED IN 4 HRS
- MAIN SIDE EFFECT IS HYPOGLYCEMIA
- MUST EAT WITHIN 30 MIN OF TAKING THIS DRUG

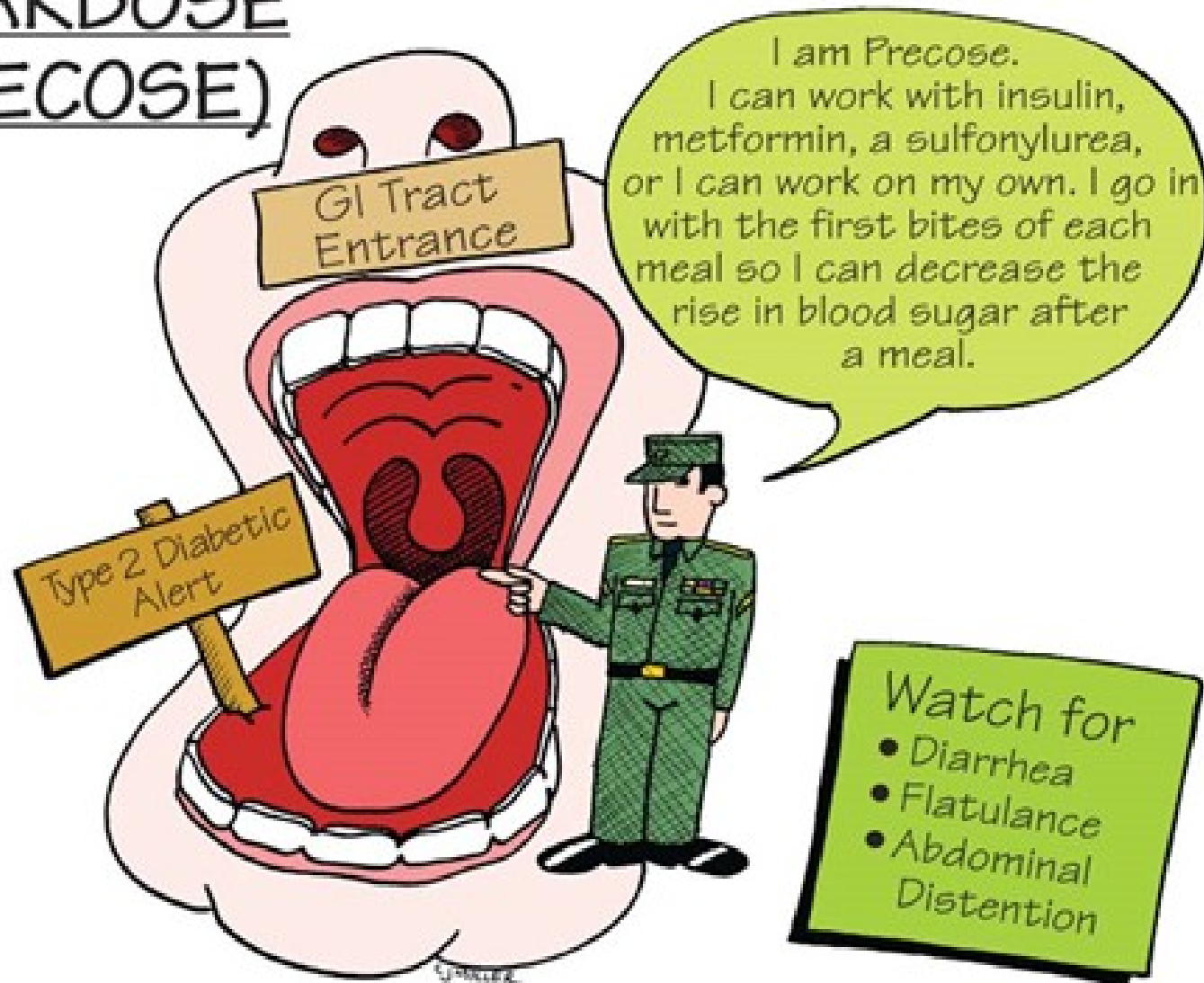
THIAZOLIDINEDIONES (GLITAZONES) OR TZD

- PROTOTYPE: pioglitazone (Actos)
- DECREASES INSULIN RESISTANCE & MAY ALSO DECREASE GLUCOSE PRODUCTION
- ADVERSE EFFECTS: URI, HA, SINUSITIS, & MYALGIA
- **CAUTION:** WITH MILD HF; AVOID IN SEVERE HF
- PEAKS IN 2 HOURS

ALPHA-GLUCOSIDASE INHIBITORS

- DELAYS CHO DIGESTION & ABSORPTION
TO ↓ POSTPRANDIAL ↑ IN BG
- ADVERSE EFFECTS: FLATULENCE,
CRAMPS, ABD DISTENTION, RUMBLING,
DIARRHEA
- TAKE WITH FIRST BITE OF MEAL
- KNOWN AS STARCH BLOCKERS
- **ACARBOSE (PRECOSE)**

ACARBOSE (PRECOSE)



DPP-4 (GLIPTINS)

- **SITAGLIPTIN (JANUVIA),
SAXAGLIPTIN (ONGLYZA),
LINAGLIPTIN (TRADJENTA),
ALOGLIPTIN (NESINA)**
- STIMULATE GLUCOSE DEPENDENT
RELEASE OF INSULIN AND SUPPRESS
POSTPRANDIAL RELEASE OF GLUCAGON
- ADVERSE EFFECTS: SORE THROAT,
RHINITIS, URI, HA, HYPOGLYCEMIA, AND
RARELY PANCREATITIS

Combination Products

❖ Combination oral therapy

- Two different classes of medications
- Risk & benefits of both drugs
 - Glucovance: glyburide & metformin
 - Metaglip: glipizide & metformin

❖ Other drugs may affect blood glucose levels

- Drug interactions can potentiate hypoglycemia & hyperglycemia

NON-INSULIN INJECTABLES

- GLP-1 RECEPTOR AGONISTS: SLOW GASTRIC EMPTYING, STIMULATE GLUCOSE-DEPENDENT RELEASE OF INSULIN, INHIBIT POSTPRANDIAL RELEASE OF GLUCAGON, AND SUPPRESS APPETITE
- **EXENATIDE (BYETTA)**
- USED IN T2DM
- NAUSEA IS COMMON

AMYLIN MIMETIC

- USED TO COMPLEMENT EFFECTS OF MEALTIME INSULIN IN T1DM AND T2DM PATIENTS
- DELAYS GASTRIC EMPTYING AND SUPPRESSES GLUCAGON SECRETION
- ACT IN THE BRAIN TO INCREASE THE SENSE OF SATIETY, HELPING TO LOWER CALORIC INTAKE
- **PRAMLINTIDE (SYMLIN)**

HYPOGLYCEMIA

**T
I
R
E
D**

Tachycardia

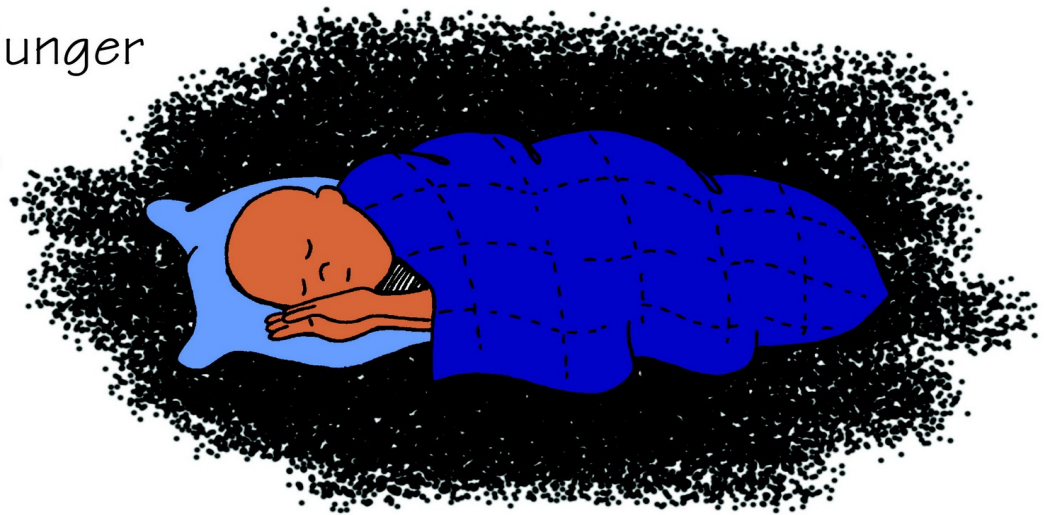
Irritable

Restless

Excessive Hunger

Diaphoresis

Depression



LONG-TERM EFFECTS OF HYPERGLYCEMIA

- MAJOR CVD: ISCHEMIC HEART DISEASE, STROKE
- LOWER-EXTREMITY AMPUTATION
- DKA, HHS
- SKIN AND SOFT TISSUE INFECTIONS
- PNEUMONIA
- INFLUENZA
- BACTEREMIA/SEPSIS
- TB

VASCULAR EFFECTS

○ MACRO EFFECTS:

- CVD/PVD

- MI

- STROKE

○ MICRO EFFECTS:

- RETINOPATHY

- PERIODONTAL DZ

- RENAL INSUFFICIENCY/
FAILURE

Chronic Complications

Macrovascular Angiopathy

❖ Decrease risk factors (yearly screening)

- Obesity
- Smoking
- Hypertension
- High fat intake
- Sedentary lifestyle

❖ Screen for & treat hyperlipidemia

Chronic Complications

Diabetic Retinopathy

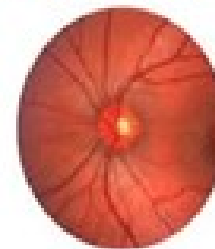
❖ Microvascular damage to retina

❖ Nonproliferative –

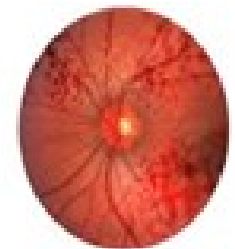
- Partial occlusion of small blood vessels in retina causes microaneurysms

❖ Proliferative

- Involves retina & vitreous humor
- New blood vessels formed (neovascularization)
- Can cause retinal detachment



Normal
Retina

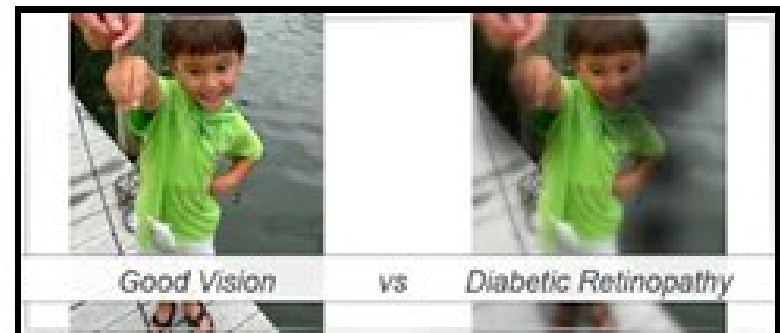


Diabetic
Retina

Chronic Complications

Diabetic Retinopathy

- ❖ Initially no changes in vision
- ❖ Annual eye examinations with dilation to monitor
- ❖ Maintain glycemic control & manage hypertension
- ❖ Exercise precautions



Chronic Complications

Retinopathy & other eye diseases

❖ Retinopathy Treatment

- Laser photocoagulation: Laser destroys ischemic areas of retina
- Vitrectomy: Aspiration of blood, membrane, & fibers inside the eye
- Drugs to block action of vascular endothelial growth factor (VEFG)

❖ Increased risk for other eye diseases

- Glaucoma
- Cataracts

Chronic Complications

Diabetic Nephropathy

❖ **Damage to small blood vessels that supply the glomeruli**

❖ **Risk factors**

- Hypertension
- Genetics
- Smoking
- Chronic hyperglycemia



Chronic Complications Diabetic Nephropathy

- ❖ **Annual screening**
- ❖ **If albuminuria present, drugs to delay progression:**
 - ACE inhibitors
 - Angiotensin II receptor antagonists
- ❖ **Control of hypertension & tight BG control**

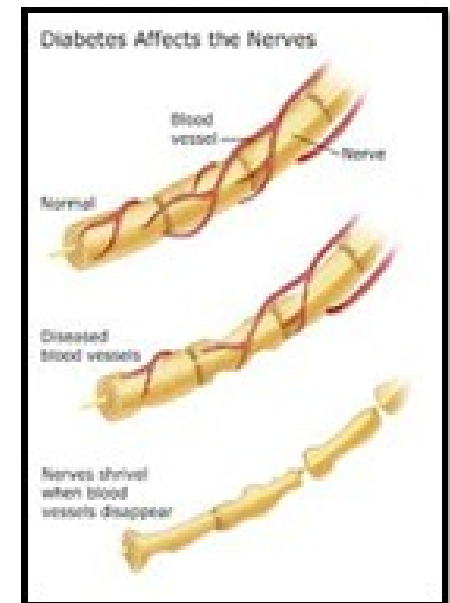
NEUROLOGICAL EFFECTS

- MECHANISMS NOT COMPLETELY UNDERSTOOD
- DAMAGE TO THE NERVE CELLS
 - DIABETIC PERIPHERAL NEUROPATHY
 - AUTONOMIC NEUROPATHY

Chronic Complications

Diabetic Neuropathy

- ❖ Nerve damage due to metabolic derangements of diabetes
- ❖ Reduced nerve conduction & demyelination
- ❖ Sensory or Autonomic



Chronic Complications

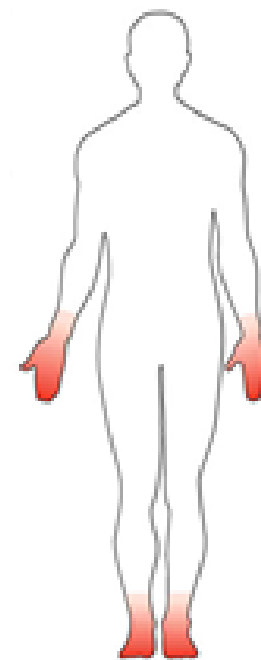
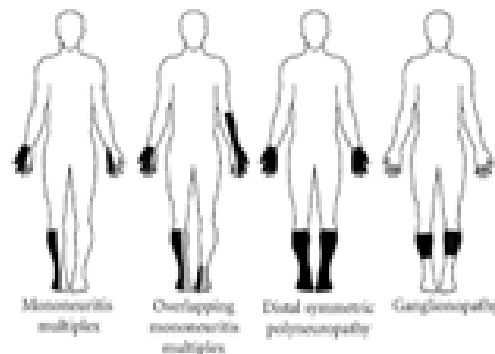
Diabetic Neuropathy

❖ Sensory neuropathy

- Loss of protective sensation

❖ Distal symmetric polyneuropathy

- Loss of sensation, abnormal sensations, pain, & paresthesias



Distal symmetric polyneuropathy

Neuropathy: Neurotrophic Ulceration



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Chronic Complications

Diabetic Neuropathy

❖ Treatment for *SENSORY* neuropathy

- Tight BG control
- Drug therapy
 - Topical creams
 - Tricyclic antidepressants
 - Selective serotonin & norepinephrine reuptake inhibitors
 - Antiseizure medications

Chronic Complications

Diabetic Neuropathy

❖ **AUTONOMIC** neuropathy

- **Gastroparesis**
 - Delayed gastric emptying
- **Cardiovascular abnormalities**
 - Postural hypotension, resting tachycardia, painless myocardial infarction
- **Hypoglycemic unawareness**



Chronic Complications

Diabetic Neuropathy

❖ Autonomic neuropathy

- **Sexual function**
 - Erectile dysfunction
 - Decreased libido
- **Neurogenic bladder** → urinary retention
 - Empty frequently, use Credé's maneuver
 - Medications
 - Self-catheterization

Chronic Complications

Foot Complications

- ❖ **Microvascular & macrovascular diseases increases risk for injury & infection**
- ❖ **Sensory neuropathy & PAD - risk factors for amputation**
- ❖ **Clotting abnormalities, impaired immune function, autonomic neuropathy**
- ❖ **Smoking increases risk**

Chronic Complications

Foot Complications

❖ **Sensory neuropathy** → loss of protective sensation → unawareness of injury

- Monofilament screening

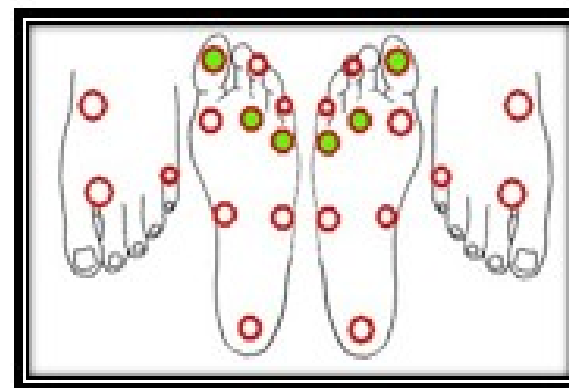
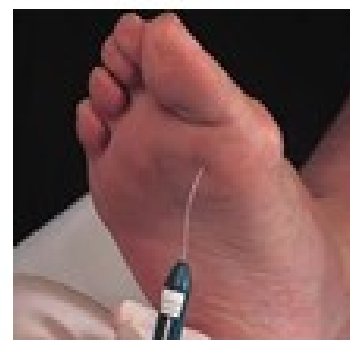
❖ **Peripheral artery disease**

- ↓ Blood flow, ↓ wound healing, ↑ risk for infection

Recommendations: Foot Care

❖ Annual comprehensive foot examination by HCP to identify risk factors predictive of ulcers & amputations.

- Inspection
- Test for loss of sensation: 10g monofilament plus
 - Vibration using 128 HZ tuning fork
 - Pinprick sensation
 - Ankle reflexes
 - Vibration perception threshold



Green dots are preferred testing areas.

Complications of Feet

❖ **Neuropathic arthropathy (Charcot's foot)**

❖ **Diabetic foot ulcers**

- Begins with soft tissue injury of foot.
- Formation of fissure between toes or in area of dry skin.
- Formation of callus.
- Ingrown toenails
- Venous insufficiency is a contributing cause of foot ulcers



Treatment of Foot Ulcers

- ❖ Bed rest
- ❖ Antibiotics
- ❖ Debridement
- ❖ Good control of BG
- ❖ If patient has PVD, ulcers may not heal
- ❖ Amputation may be necessary



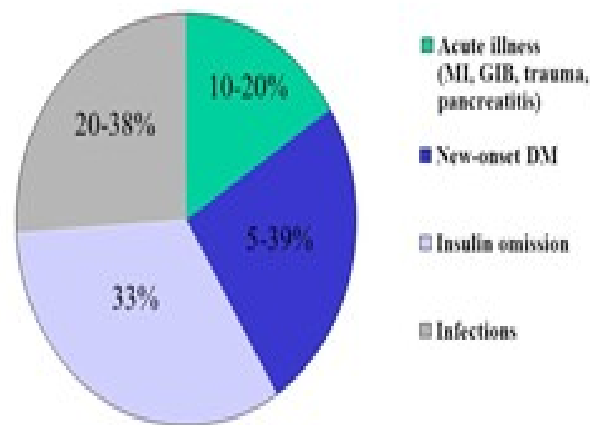
From Gross R, Jansen R. Clinical endocrinology and diabetes: an illustrated colour text. Edinburgh, 1998. (Reprinted with permission)

Diabetic Ketoacidosis (DKA)

❖ Precipitating factors

- Infection
- Inadequate insulin dose
- Illness
- Undiagnosed T1DM

DKA: Precipitating Factors



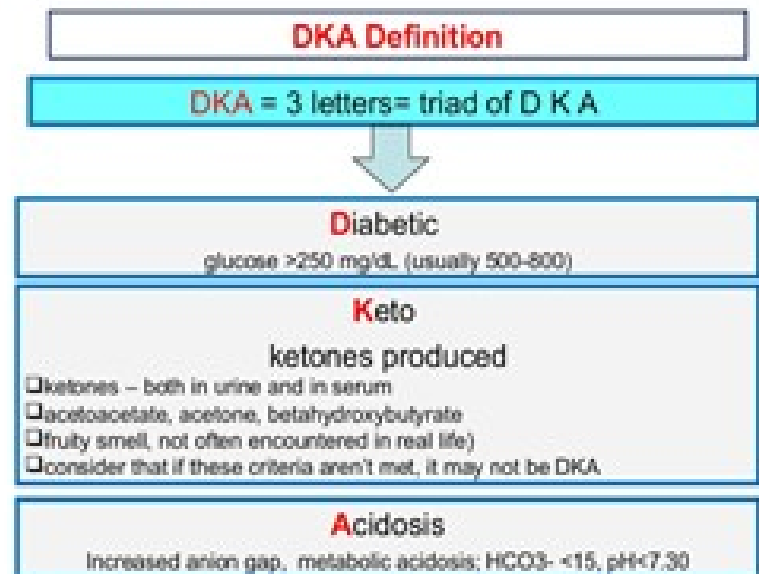
Diabetic Ketoacidosis - Patho

❖ Caused by profound deficiency of insulin

❖ Characterized by

- Hyperglycemia
- Ketosis
- Acidosis
- Dehydration

❖ Most likely to occur in T1DM



Dka Symptoms & Testing

❖ Clinical manifestations

- Abd pain, anorexia, N/V
- Kussmaul respirations
- Sweet, fruity breath odor

❖ Lab work

- BG level of 250 mg/dL or higher
- Blood pH < than 7.30
- Serum bicarbonate level < 16 mEq/L
- Moderate to high ketone levels in urine or serum





DIABETIC KETOACIDOSIS



Onset Slow
4-10 Hours

Lack of Insulin



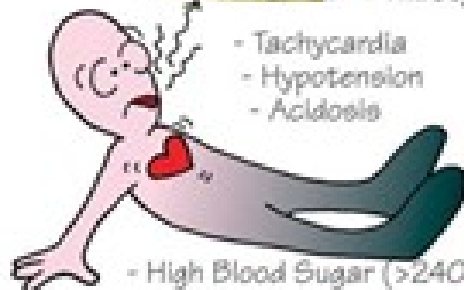
GI Upset

Fever/Illness

- Breath Smells Like...



- Kussmaul Respirations
- Thirsty, Dehydration



- Tachycardia
- Hypotension
- Acidosis

- High Blood Sugar (>240 mg/dl)
- Hyperkalemia
- Polyuria

Hi...E



Hydration
Insulin
Electrolyte
Replacement

DKA vs. HHS

DKA

- Most often seen in T1DM
- Rapid onset
- BG > 250 mg/dL
- pH < 7.3
- Bicarb < 15 or 16
- Ketones-urine/serum +
- Anion Gap +

HHS

- Occurs more common in elderly
- Gradual onset
- BG > 600 mg/dL
- pH > 7.3
- Bicarb > 30
- Ketones urine/serum -
- Anion Gap -

Hyperosmolar Hyperglycemic Syndrome (HHS)

❖ Life-threatening syndrome

❖ Occurs with T2DM

❖ Precipitating factors

- UTIs, pneumonia, sepsis
- Acute illness
- Newly diagnosed T2DM
- Impaired thirst sensation and/or inability to replace fluids

HHS Pathology

- ❖ Enough circulating insulin to prevent ketoacidosis
- ❖ Fewer symptoms lead to higher glucose levels
- ❖ More severe neurologic manifestations – 2nd to ↑ serum osmolality
- ❖ Lab
 - BG > 600mg/dL is possible
 - Ketones absent or minimal in blood & urine

DKA & HHS: Nursing Management

❖ Monitor

- Electrolytes
- IV fluids
- Insulin therapy

❖ Assess

- Renal status
- Cardiopulmonary status
- Level of consciousness

Hypoglycemia Signs & Symptoms

❖ Common manifestations

- Shakiness
- Palpitations
- Nervousness
- Diaphoresis
- Anxiety
- Hunger
- Pallor



Hypoglycemia Treatment

❖ Check BG level

- If less than 70 mg/dL, begin treatment
- If more than 70 mg/dL, investigate further for cause of signs/symptoms
- If monitoring equipment not available, treatment should be initiated

Hypoglycemia Treatment

❖ Rule of 15 in 15

- Consume 15 g of a simple carbohydrate
 - Fruit juice or regular soft drink, 4 to 6 oz.
- Recheck glucose level in 15 minutes
 - Repeat if still less than 70 gm/dL
- Avoid foods with fat
 - Decrease absorption of sugar
- Avoid overtreatment
- Give complex CHO after recovery



15 Rule of
Fifteen

Examples of 15 grams of carbohydrates:



3-4 Glucose Tabs
OR
1 tube Glucose Gel



3-5 Pieces of
Hard Candy
(NOT
chocolate)



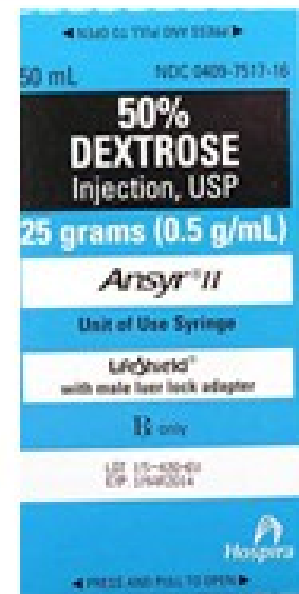
$\frac{1}{2}$ cup (4 oz.)
Juice or Regular
Soda
(NOT diet soda)

Hypoglycemia Hospitalized Patient

❖ Treatment

- See orders or hospital protocol
- 15 in 15 rule generally followed
- If patient not alert enough to swallow
 - Fifty percent dextrose, 20 to 50 mL, IV push
 - Glucagon, 1 mg, IM or subcutaneously

❖ Explore reason why occurred



Glucagon

- ❖ **MOA:** stimulate conversion of glycogen to glucose
- ❖ **Peak:** 15-30 min. Lasts 90 min. (IV, SQ or IM)
- ❖ **Adverse effects:** N/V, allergic reaction
- ❖ **Reconstitute** –Sterile Water
- ❖ **Caution:** Risk for aspiration; follow with complex CHO;
recheck BG



Somogyi Effect

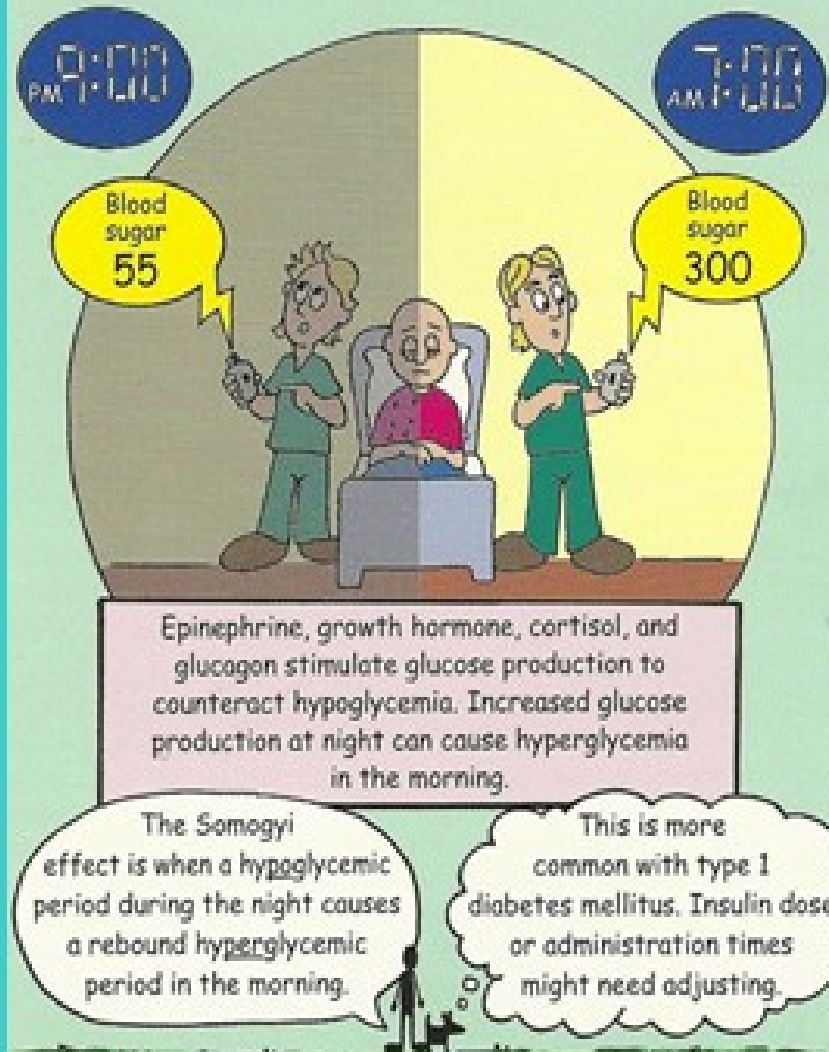


❖ Somogyi effect

- *Rebound effect* in which an overdose of insulin causes hypoglycemia
- Release of counterregulatory hormones causes *rebound* hyperglycemia



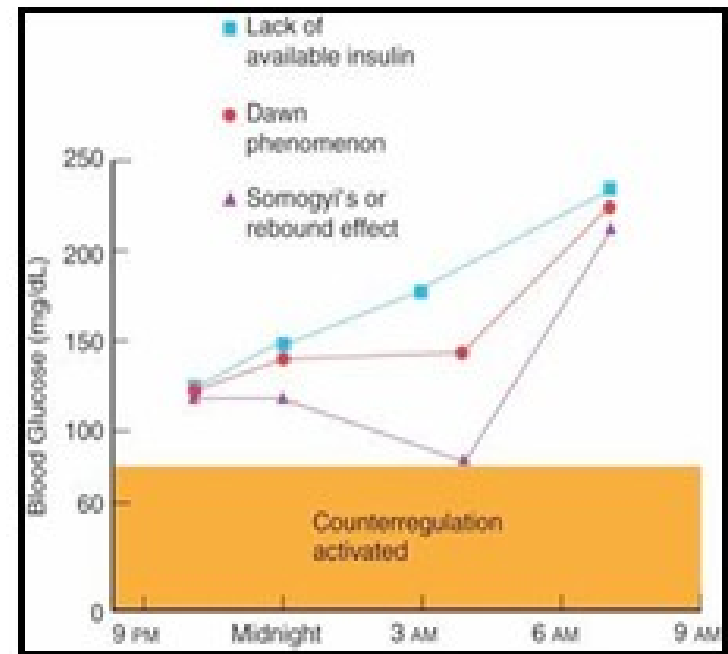
SOMOGYI EFFECT



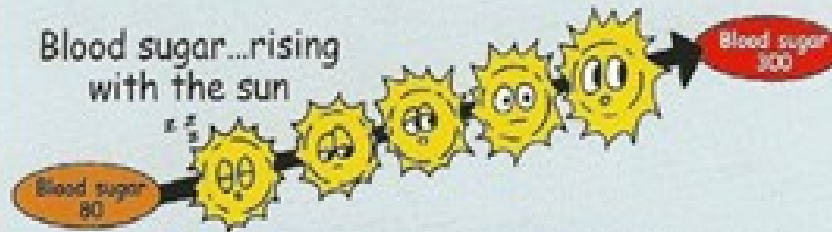
Dawn Phenomenon

❖ Dawn phenomenon

- Morning hyperglycemia present on awakening
- Possible R/T release of counterregulatory hormones
 - Growth hormone and cortisol



DAWN PHENOMENON



Growth hormone released during the night decreases peripheral glucose uptake, causing the hyperglycemia.

Here comes the sun!

The dawn phenomenon takes place early in the morning. With the rise of the sun, a rise in the blood glucose concentration occurs with no hypoglycemia during the night.

HYPOKALEMIA

- PROMOTES UPTAKE OF POTASSIUM BY CELLS
- ACTIVATES A MEMBRANE BOUND ENZYME
- IF TOO MUCH INSULIN SIGNIFICANT HYPOKALEMIA CAN OCCUR
- EFFECTS ON HEART OF BIGGEST CONCERN

LIPOHYPERTROPHY

- ACCUMULATION OF SQ FAT WHEN INSULIN IS INJECTED TOO FREQUENTLY AT S

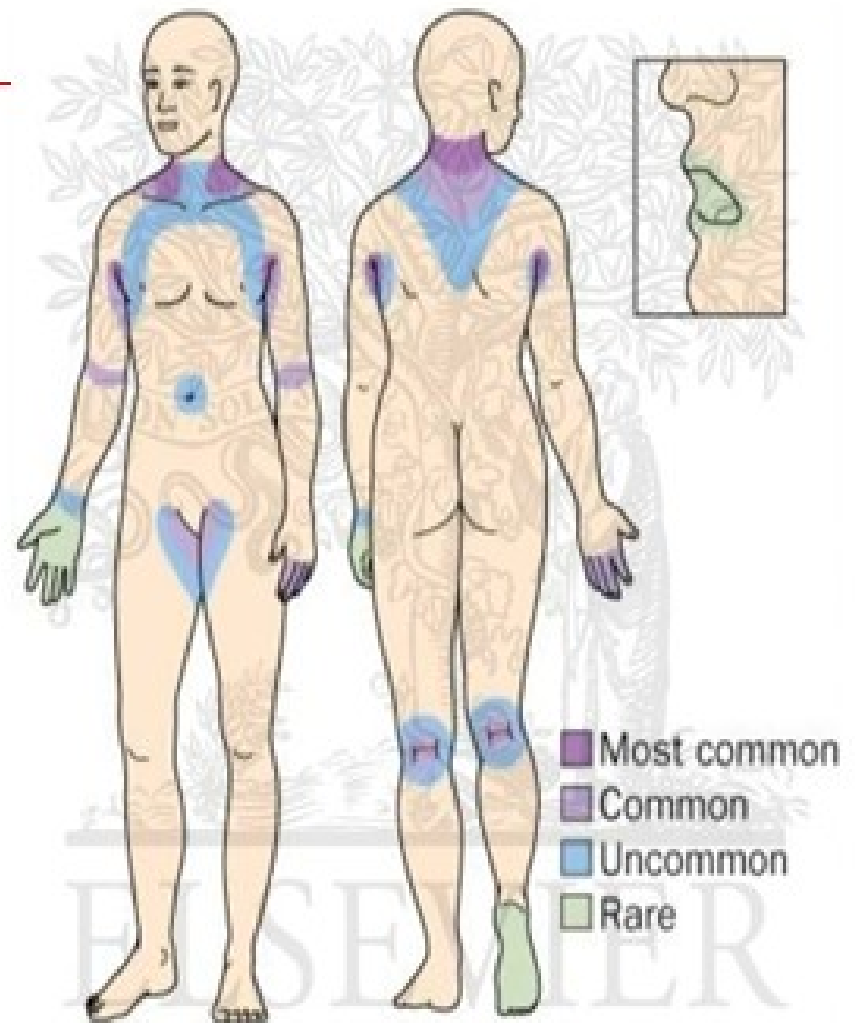


DIABETIC DERMOPATHY

- AKA "shin spots" or pigmented pretibial papules
- **Most common** cutaneous manifestation of diabetes
- Benign asymptomatic red brown macules on shins
- No treatment needed



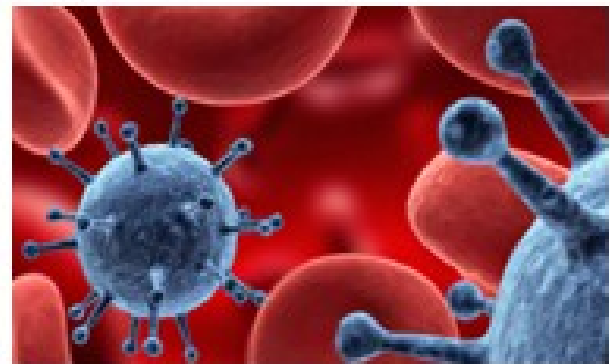
Acanthosis nigricans



Chronic Complications

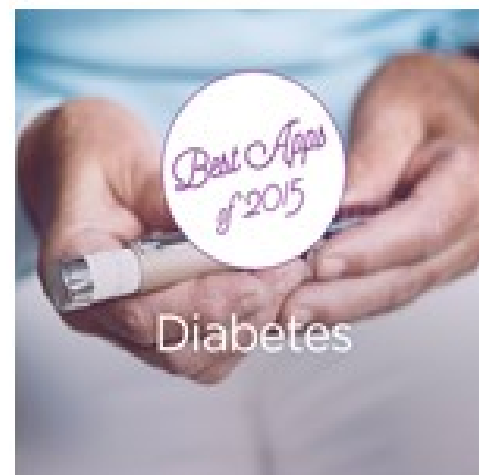
Infection

- ❖ Defect in mobilization of inflammatory cells & impaired phagocytosis
- ❖ Recurring or persistent infections
- ❖ Treat promptly & vigorously
- ❖ Patient teaching for prevention
 - Hand hygiene
 - Flu & pneumonia vaccine



Prevent Complications

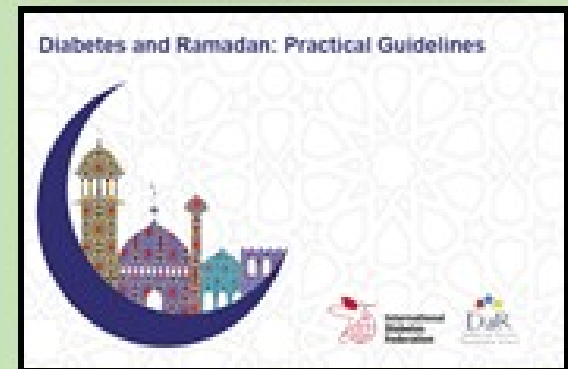
- ❖ Patient education
- ❖ Assess barriers to learning
- ❖ Teach in increments – What does pt.. want to learn?
- ❖ Promote self care
- ❖ Adjust regimen to meet needs



Adherence to Diabetes Management

❖ Barriers

- Degree of life changes & complexity of management plan
- Cost of care
- Cultural factors
- Lack of family support
- Other stressors
- Lack of Knowledge
- Fears



Strategies to Increase Adherence

- ❖ Encourage patient & family to take charge of their health
- ❖ Simplify the regimen
- ❖ Focus on the normal not the differences
- ❖ Teach the tools & help pt.. get supplies
- ❖ Provide a safe harbor
- ❖ Provide adequate education

NOVEMBER
DIABETES
AWARENESS
MONTH

National

Goals of Nutrition Therapy



- ❖ **Maintain BG levels**
- ❖ **Lipid profiles & BP levels**
- ❖ **Prevent/ slow rate of chronic complications**
- ❖ **Nutritional needs & personal, cultural, & economic needs**
- ❖ **Maintain the pleasure of eating**

General Guidelines – T1DM

❖ Meal planning

- Based on usual food intake and preferences
- Portion control
- Balanced with insulin and exercise patterns



❖ Day-to-day consistency

- ❖ **More flexibility with:** rapid-acting insulin, multiple daily injections, and insulin pump

General Guidelines – T2DM

❖ Emphasis on achieving glucose, lipid, and BP goals

❖ Weight loss

- Nutritionally adequate meal plan with ↓ fat and CHO
- Weight management
- Spacing meals
- Regular exercise



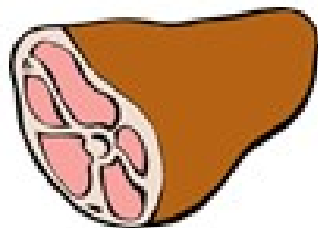
General Guidelines - Carbohydrate

- ❖ CHO should be 45%-60% of daily caloric intake
- ❖ Grains, fruits, legumes, & milk
- ❖ Minimum 130 Grams/day
- ❖ Fiber intake of 25-30 grams/day
- ❖ Limit refined grains & sugars



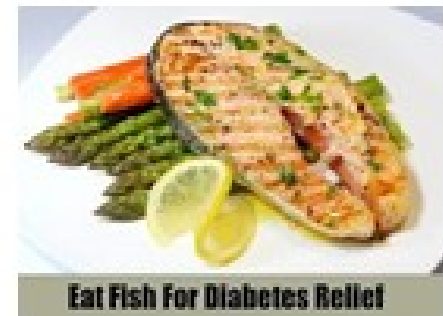
General Guidelines - Protein

- ❖ 15 - 20% of total calories consumed
- ❖ High protein diets are not recommended
- ❖ Protein may reduce in patients with kidney failure



General Guidelines - Fat

- ❖ Saturated fat < 7% of total calories
- ❖ Minimize Trans fat
- ❖ Limit dietary cholesterol < 200 mg/day
- ❖ Fish – polyunsaturated fats
- ❖ Health fats from plants



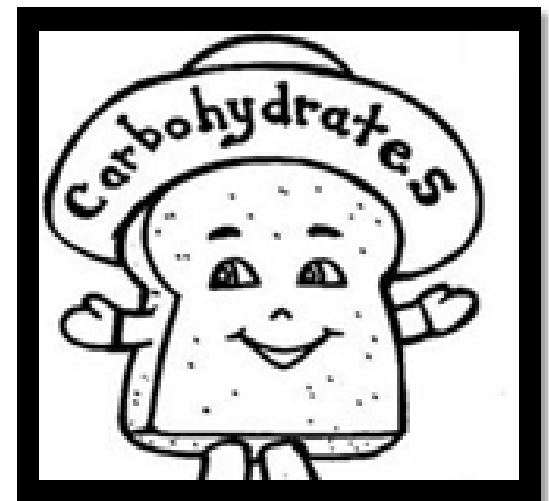
Eat Fish For Diabetes Relief

Glycemic Index

- ❖ Glycemic Index of 100 refers to the response to 50 grams of glucose or white bread in a normal person without diabetes
- ❖ Foods with a high glycemic index raise glucose levels faster & higher than foods with a low glycemic index
- ❖ May provide a modest additional benefit over consideration of total carbohydrates alone

Carbohydrate Counting: Focus on Consistency

- ❖ 1 Carbohydrate Choice = 15 Grams
- ❖ Spread carbohydrates throughout the day
- ❖ Consistency
- ❖ Portion sizes



Carbohydrate Goals

- ❖ Men: 4 carb. Choices/meal (60 grams)
- ❖ Women: 3 carb. Choices/meal (45 grams)
- ❖ Snacks: 1-2 carb. Choices (15-30 grams)
- ❖ Insulin dose R/T no. of CHO eaten



Sugar-Free Foods

- ❖ Sugar-free does **not** mean carbohydrate-free
- ❖ Sugar-free foods often higher in saturated fat compared to the regular product
- ❖ Teach patients importance of reading labels

total carbs



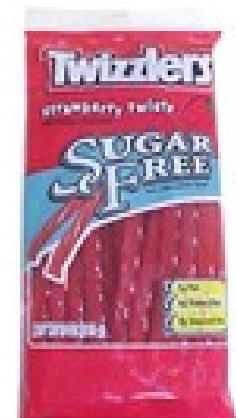
Nutrition Facts			
Serving Size 1/2 cup (125g)			
Amount Per Serving			
		% Daily Value*	
Total Fat	12g	24%	12g
Saturated Fat	8g	16%	8g
Trans Fat	0g	0%	0g
Cholesterol	0mg	0%	0mg
Sodium	190mg	40%	190mg
Total Carbohydrate	20g	4%	20g
Dietary Fiber	3g	6%	3g
Sugars	1g	2%	1g

Nutrition Facts			
Serving Size 1/2 cup (125g)			
Amount Per Serving			
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Sugar Alcohols

- ❖ Found in most sugar-free foods
- ❖ Sugar alcohols include: sorbitol, mannitol, xylitol, & isomalt.
- ❖ Sugar alcohols eaten in large quantities
 - Abd cramping, flatulence, & diarrhea



Timing of Meals/Snacks

- ❖ **Check blood sugar before meals**
- ❖ **Check blood sugar two hours after meals**
- ❖ **Certain oral medications can cause low blood sugars, if patient is not eating at same time every day**
- ❖ **Sulfonylureas - glyburide & glipizide**



Timing of Meals/Snacks

❖ **Fixed insulin regimen:**

consistency

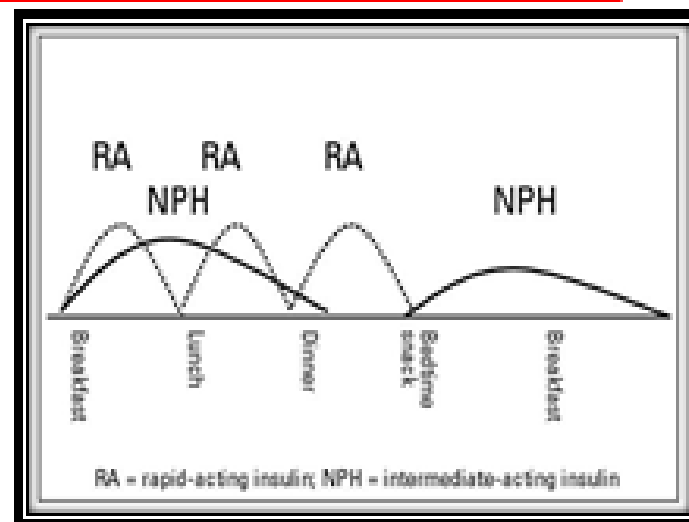
❖ **Rapid-acting insulin:**

can adjust dose before meal

based on current BG & CHO meal

❖ **Intensified insulin therapy/insulin pump:**

allows more flexibility





If Drink Alcohol:

- ❖ **Don't skip meals**
- ❖ **Risk of a low blood sugar**
- ❖ **May increase triglycerides**
- ❖ **Check with diabetes care team**



Patient & Caregiver Education

- ❖ Disease process
- ❖ Exercise
- ❖ Meal & Snacks Planning
- ❖ Medication Adherence
- ❖ SMBG
- ❖ Psychosocial
- ❖ Risk Reduction & Monitoring



DIABETES AND EXERCISE



General Exercise Recommendations

- ❖ Exercise same amount & at the same time
- ❖ Complications from diabetes: alter exercise type & amount
- ❖ Type/amount of exercise
 - Moderate activity a minimum 150 min. /wk. aerobic
 - Resistance training 2 – 3 times/week**
 - No more than 2 consecutive days w/o exercise

T1DM & Exercise

❖Benefit:

- Better BG control & require less insulin
- Prevent/delay complications

❖Glucose lowering effect may last up to 48 hours

❖Exercise 1 – 2 hours after a meal

❖Do not inject insulin to extremity about to be exercised

❖Monitor BG: before, during, & after

❖Do not exercise if:

- BG level $> 250\text{mg/dL}$ or if ketones are present in urine
- BG < 100 Eat snack & recheck BG

T2DM & Exercise

❖ Benefits

- ↓ Insulin resistance & BG
- Weight loss
- ↓ Triglycerides & LDL , ↑ HDL
- ↓ BP & improve circulation

Medication & Exercise

- ❖ Patients who use insulin, meglitinides, & sulfonylureas at increased **risk** for hypoglycemia
- ❖ Do not exercise when medication is at its **peak**
- ❖ Test **BG** before & after exercise



Food & Exercise



- ❖ **Eat enough to maintain adequate BG levels**
- ❖ **Always carry a fast-acting source of CHO**
- ❖ **May need small CHO snacks every 30 minutes**

EXERCISE GUIDE FOR DIABETIC FITNESS

F Frequency

Regular (3x to 4x Per Week)

I

Intensity

60-80% Of Maximal Heart Rate

T

Time

Aerobic Activity
20-30 Min.
With 5-10 Min.
Warm Up



General Nursing Assessment of Client with Diabetes

❖ **SUBJECTIVE data:** Information & History

- Past health history
 - Viral infections, infection, pregnancy, family H/O diabetes
- Medications
 - Insulin, OAs, corticosteroids, diuretics, phenytoin
- Recent surgery

See: Lewis_Table 49-12

Nursing Assessment

❖ **SUBJECTIVE data: Health Patterns**

- Health perception & management
- Nutritional
- Elimination
- Activity level or fatigue
- Cognitive perceptual
- Sexual - reproductive
- Coping
- Value-belief

Nursing Assessment

❖ OBJECTIVE data

- Eyes
- Skin
- Respiratory
- Cardiovascular
- GI
- Neurological
- Musculoskeletal

Nursing Assessment: Lab work

❖ Objective data

- Serum electrolyte or acid-base abnormalities
- Fasting BG (FBG) level of 126 mg/dL or higher
- A1C > 6.0%
- Oral glucose tolerance test (OGTT) *and/or* Random glucose level > 200 mg/dL
- ↑ Blood urea nitrogen, creatinine
- ↑ Triglyceride, cholesterol, LDL, & ↓ HDL
- Urine - + for glucose, ketones or albumin

Nurse Planning

❖Overall goals

- Active patient participation
- Maintain normal BG levels
- Adjust lifestyle to accommodate diabetes regimen
- Few or no episodes of hypoglycemia or acute hyperglycemic emergencies
- Prevent or minimize chronic complications

Nursing Implementation

❖ Ambulatory & home care

- Overall goal patient / caregiver optimal level of independence
- Consult with a dietician
- Use services of certified diabetes educator (CDE)
- Establish individualized goals for teaching
- Include family & caregivers

Nursing Implementation

❖ Ambulatory & home care

- Assess ability to perform SMBG & insulin injection
 - Utilize assistive devices as needed
- Assess knowledge & ability to manage diet, medication, & exercise
- Teach manifestations & how to treat hypoglycemia & hyperglycemia
- Sick Day Rules

Nursing Implementation

❖ Ambulatory & home care

- Frequent Oral care
- Annual exams: eye, lab, feet & other specialties as needed
- Foot Care
- Travel needs
 - Medication, supplies, food, activity



Nursing Management: Evaluation

❖ Expected outcomes

- Knowledge
- Self-care measures
- Balanced diet & activity
- Stable, normal BG levels
- No injuries



Nursing Care of Special Populations & in Special Situations



Cultural Considerations

- ❖ Cultural perceptions of health may vary
- ❖ Culture & tradition influence diet & food preparation
- ❖ Communicate effectively
 - Literacy, English proficiency, or non-English speakers
 - Appropriate teaching materials
- ❖ Socioeconomic status may effect health care choices

Gerontologic Considerations

- ❖ **Increased prevalence & mortality**
- ❖ **Glycemic control challenging**
 - Increased hypoglycemic unawareness
 - Functional limitations
 - Renal insufficiency
- ❖ **Diet & exercise: main treatment**
- ❖ **Patient teaching must be adapted to needs**



Nursing Implementation in Special Situations

❖ Acute illness, injury, & surgery – General Principles

- ↑ BG level secondary to counter-regulatory hormones
- T1DM may ↑ insulin needs
- T2DM may necessitate insulin therapy
- Frequent monitoring of BG
 - Urine ketone testing if BG > 240 mg/dL
 - Report BG > 300 mg/dL for two tests or moderate to high urine ketone levels

Sick Day Rules

❖ Acute illness “Sick Day Rules”

- Maintain normal diet if able
- Increase noncaloric fluids
- Continue taking antidiabetic medications
- If normal diet not possible, supplement with CHO-containing fluids while continuing medications



Sick day Rules	Type 1	Type 2
Hydration	8oz. Fluid per hour Every 3 rd hour, consume 8oz of a sodium rich choice like bouillon	Same
SMBG	Every 2-4 hours while BG is elevated or until symptoms subside	Same
Ketones	Every 4 hours or until negative	Determined for the individual
Medications Adjustments	Continue as able Adjust insulin doses to correct hyperglycemia Instruct patients to call their healthcare provider for specific instructions	Hold metformin during serious illness
Food & Beverage Selections	Guide patients to consume 150-200g CHO daily in divided doses Switch to soft or liquids as tolerated	Same
Contact healthcare Provider	Vomiting more than once, diarrhea more than 5X or for longer than 6 hrs... BG > 300 X2 Moderate to lg. urine Ketones	Same

Nursing Care in Special Situations

❖ Perioperative care

- Verify orders
- May Hold or reduce insulin dose morning of surgery (NPO)
- During stress such as surgery, BG levels may rise
- IV fluids & insulin
- Frequent monitoring of BG
 - Hyperglycemia leads to loss of fluids & electrolytes

Hospitalization

❖ Factors affecting hyperglycemia

- Changes in treatment regimen
- Medications (glucocorticoids)
- IV Dextrose
- Overly vigorous treatment of hypoglycemia

Hospitalization

❖ Factors affecting hypoglycemia

- Overuse of sliding scale
- Lack of dosage changes when dietary intake is changed.
- Overly vigorous treatment of hyperglycemia
- Delayed meal after lispro or aspart insulin

Alterations in Meal Plan

❖ If pt. is NPO

- insulin dose may need to be held or changed
- Frequent BG monitoring.

❖ If pt. on Clear Liquids: the CL need to be caloric

❖ Enteral Feeding

- Monitor BG & give insulin at *regular* intervals

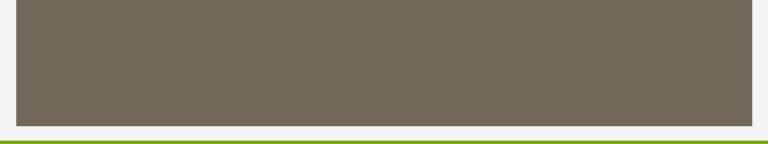
❖ Parenteral nutrition

- intravenous nutrition solution – may contain insulin

Resources

- ❖ Certified Diabetic Educators – inpatient & community
- ❖ Local ADA 806-794-0691
- ❖ National 1-800-DIABETES
- ❖ www.diabetes.org

Persons with diabetes mellitus can live a long and healthy life
if they control their diabetes instead of
letting the diabetes control them!



THE END !!!!!