Diabetes and Kidney Disease A Balancing Act

Patricia Davidson DCN, RDN, CDE, LDN
West Chester University-PA
pdavidson@wcupa.edu

Objectives

- To be able to describe the multifactorial influences in the development of renal disease in diabetes
- Identify potential barriers to managing renal disease and diabetes
- To state at least 3 nutritional interventions for achieving metabolic goals for renal disease and diabetes management

Glucose regulation and homeostasis

DIABETES OVERVIEW

Type 1 (T1DM)

Results from beta-cell destruction (autoimmune)

Leads to absolute insulin deficiency

Type 2 (T2DM)

Progressive insulin secretory defect

Background of insulin resistance

Regulation of Fasting Glucose

- Primary factor -Hepatic glucose production
- Regulation of fasting hepatic glucose production involves
  - Fasting, background (basal) plasma insulin
  - Hepatic sensitivity to insulin
  - Fasting substrate availability
- In Type 2 diabetes
  - Basal insulin secretion is impaired
  - Hepatic sensitivity to insulin is decreased

Regulation of Postprandial Glucose

- A meal contains 6 to 20 times the glucose content of the blood
- Regulation of postprandial hyperglycemia usually involves
  - Clearance by the liver
  - Suppression of hepatic glucose production
  - Peripheral clearance of glucose

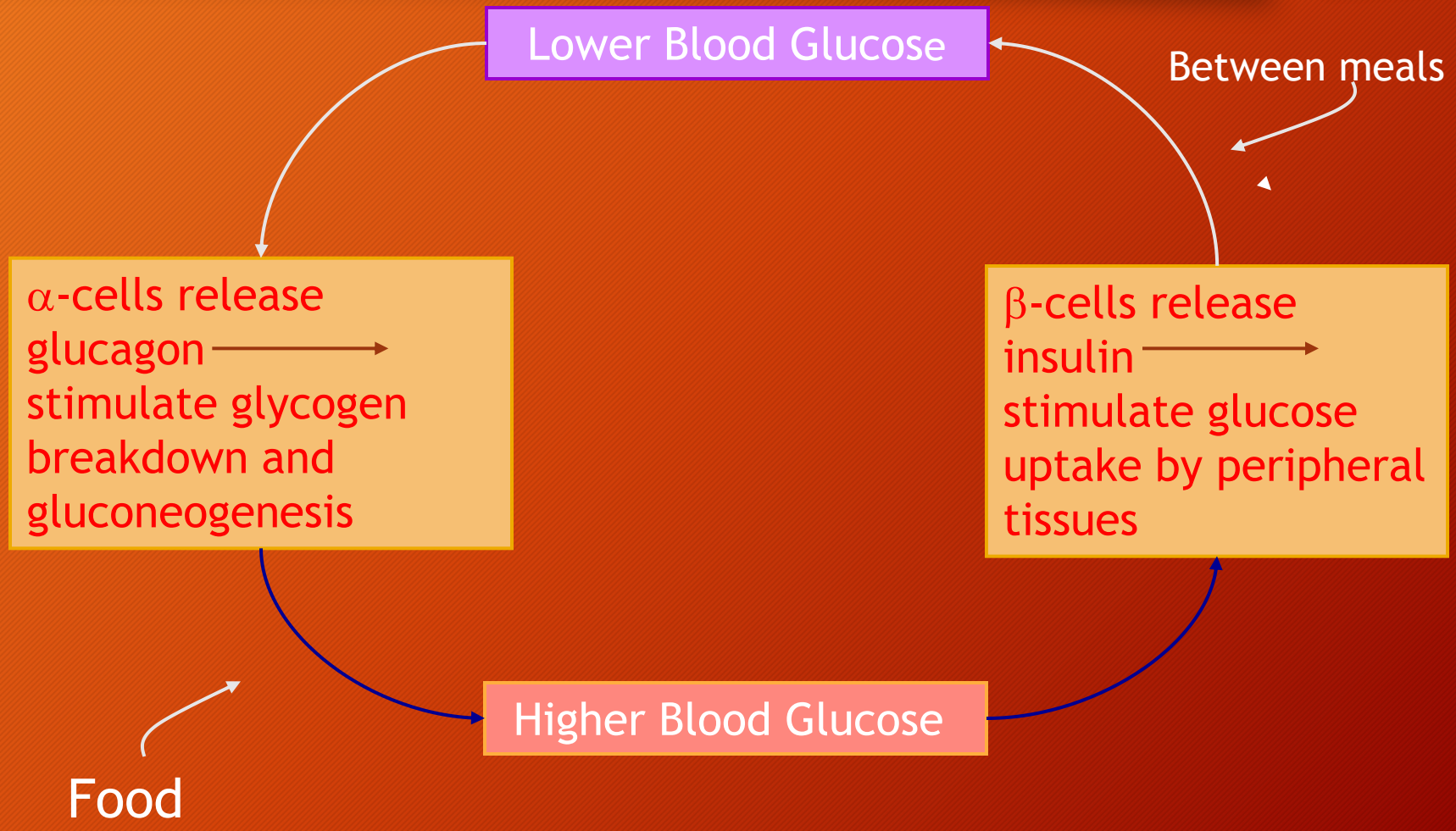
What Occurs in Impaired Postprandial Glucose Regulation

- In impaired glucose tolerance or diabetes, glucose regulation is impaired by
  - Delayed and reduced insulin secretion
  - Lack of suppression of glucagon
  - Hepatic and peripheral insulin resistance
  - Resulting in:
- Postprandial hyperglycemia & hyperinsulinemia

Glucose Equilibrium – A Wonder

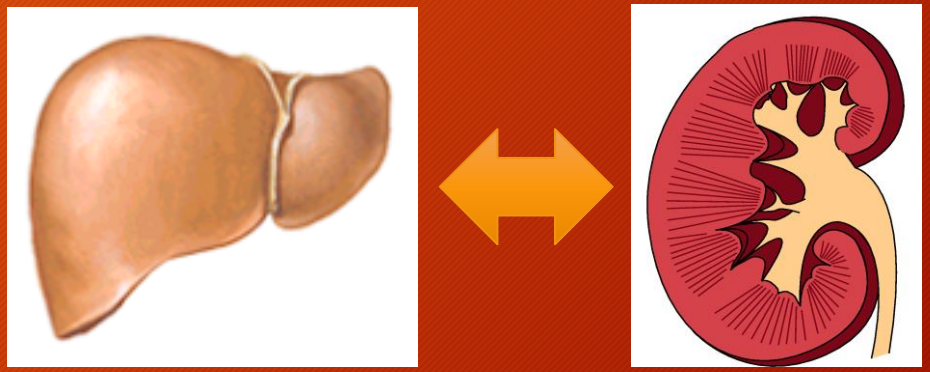
- Normal Blood Glucose
  - Fasting state : 60 to 100 mg/dL
  - Postprandial : 100 to 140 mg/dL
- What keeps the blood glucose in such a narrow range?

Glucose Homeostasis



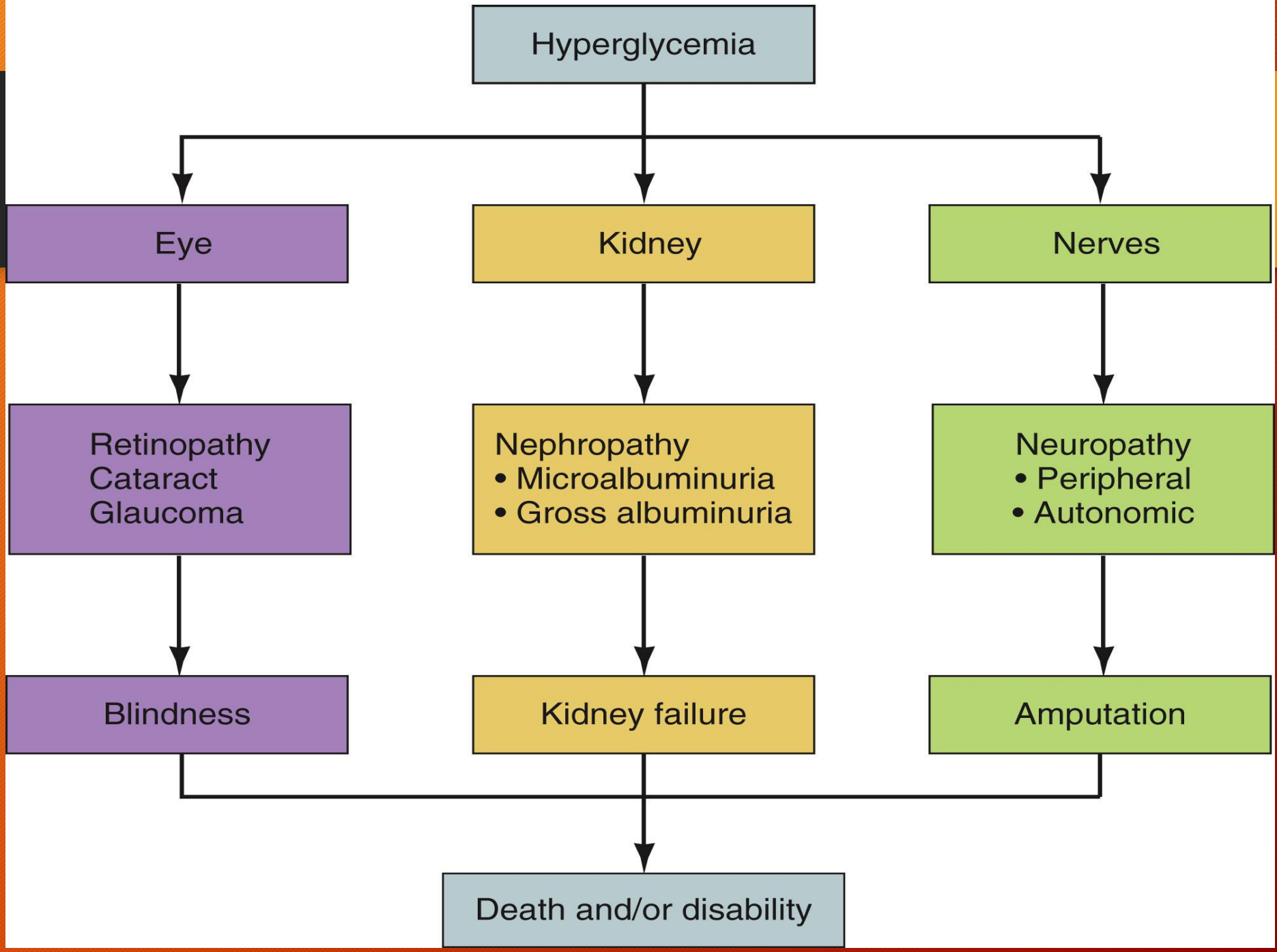
Liver and Kidney

- Major source of net endogenous glucose production
- Uses gluconeogenesis and glycogenolysis r/t low BG
- Converts it to fat and incorporated into VLDL for transport
- Kidney key player

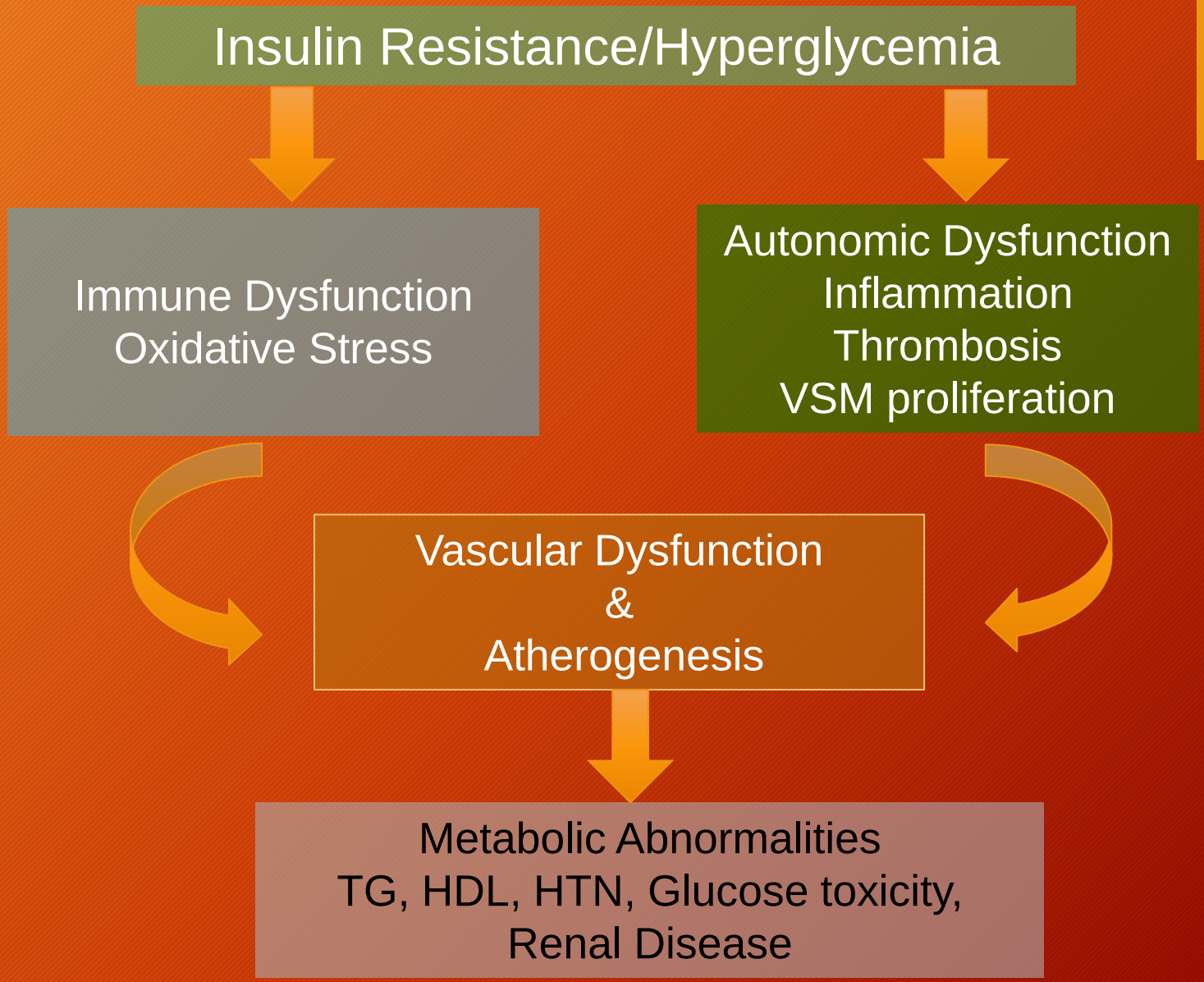


Renal Glucose Control

- Post-absorptive or fasting state
  - The kidney high capacity to produce glucose
  - Gluconeogensis –liver/renal rivalry but equal
- Post-Prandial
  - No glycogenolysis or gluconeogensis by liver
  - Renal gluconeogensis 2x and 60% PP glucose
  - Hepatorenal glucose reciprocity
- Re-absorption
  - Returns glucose to the circulation from glomerular filtrate


Hyperglycemia
Eye
Kidney
Nerves
Retinopathy
Cataract
Glaucoma
Nephropathy
• Microalbuminuria
• Gross albuminuria
Neuropathy
• Peripheral
• Autonomic
Blindness
Kidney failure
Amputation
Death and/or disability

PATHOGENESIS OF COMPLICATION DEVELOPMENT



Management and Barriers

Barriers

- Alterations in glucose metabolism with renal failure
- Elements of treatment plans to control
- Diabetes and impact on ESRD patient population
- Psychosocial and physiological factors influencing diabetes management

Despite the evidence: “The standard is that patients should see a dietitian, less than 13% who start dialysis have seen one.”

Nephrologist, Dr. Narva

JADA, March, 2010; p 349

Alterations in Glucose Metabolism in Diabetes Patients with Renal Failure

Increase release of glucose into the circulation

- Gluconeogensis increases 2 fold
- Glucose reabsorption increases
- Glucose uptake –post absortive and prandial increase

Psychosocial Factors Influencing Diabetes Management

- Food insecurity
- Food desert
- Stigmatization
- Depression = non-compliance

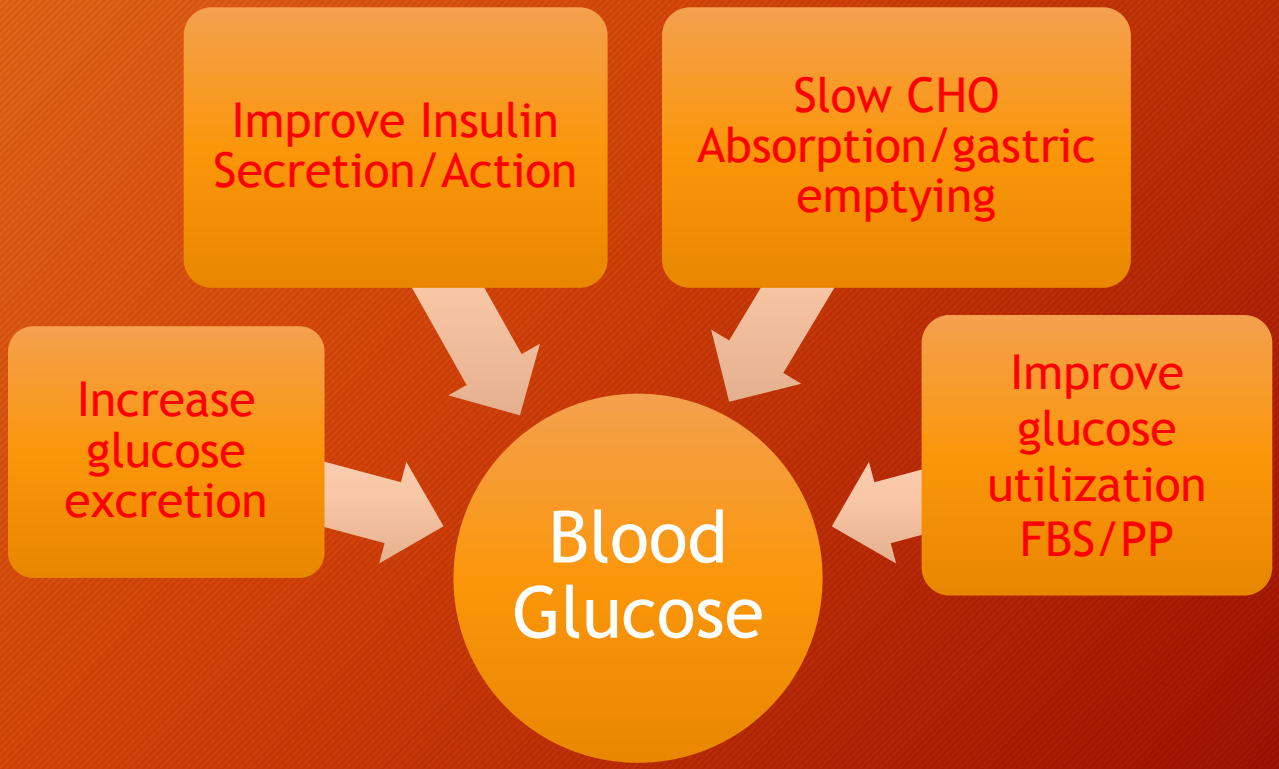
Insight Oriented

- Focus on awareness, internal motivations
- Understanding self and relationships
- Counseling strategies may evoke strong emotions

Action Oriented

- Focus on specific changes in cognition, feeling, behavior
- Relationship between thinking, emotions, and behavior
- Counseling strategies focus on problem-solving

Approaches to Lower Blood Glucose



Diabetes and Impact on Diabetes Related ESRD

- Renal clearance of insulin is diminished
- Hepatic clearance of insulin declines
- Insulin resistance and diminished insulin secretion secondary hyperparathyroidism and activated vitamin D deficiency
- Decrease renal gluconeogenesis
- Hypoglycemia

Nutrition Related "Burnout" in Diabetes and Renal Disease

- Imposed dietary restrictions
- Prescribed medications
- Diminished food intake due to anorexia, diabetic gastroparesis
- Protein-energy wasting (malnutrition-inflammation complex)

Measures of Glycemic Control

- A1c 6-7%
- Less than 6% associated with poorer outcomes
- Confounded by:
  - anemia or erythropoiesis
- Consider using:
  - glycated fructosamine and glycated albumin

Insulin Pumps
Continuous Subcutaneous Insulin Infusion (CSII)

- For motivated patients
- Expensive
- External, programmable pump connected to an indwelling subcutaneous catheter
  - Only rapid-acting insulin
  - Programmable basal rates
  - Bolus dose - pumps with dose calculator function
- Requires support system of qualified providers

Why an Insulin Pump?

Benefits

- Improved glycemic control
- Reduced complications of diabetes
- More flexibility and freedom
- Improved weight control
- Fewer injections and precision in dosing

More adjustments can be made

- Illness
- Dawn phenomenon
- Exercise
- Long meals
- Gastro paresis

Nutrition Management

"What Do I Eat"

The Renal Diet

Is there a typical renal diet order?

2gm Na 2gm K 1gm P04

60-80gm Protein Diet

with possible fluid restriction

Goals of Medical Nutrition Therapy in Diabetes

- Achieve blood glucose goals
- Achieve optimal lipid goals
- Provide appropriate calories
  - Reasonable weight
  - Controlled weight loss if ob/ow
- Prevent, delay, or treat nutrition-related complications

Ranges of Macronutrients

- Protein 15-20% of the calories
  - Modify based on renal function
- Carbohydrate 45-60%
  - Low CHO diets not recommended in managing DM
    - General recommendation (40-45%)
    - Restriction of CHO <130 g/day not recommended
    - Fibrous/plant based diet preferable - Blunts post prandial glucose peaks
- Fat 30-35%
  - <10% energy from saturated fats
  - Emphasis on monounsaturated fat

Flexibility in Meal Planning

- Patient's resistance to insulin therapy (Type 2 DM)
- Glycemic index and load need to be considered
- Assess patient's participation in care
- Assess willingness to trade carbohydrates for lean protein and high monounsaturated fat foods
  - Monitor renal function/lab parameters (ESRD)
  - Monitor blood lipids

Carbohydrate Counting

Who Can Benefit?

- T1DM and T2DM
- Weight management
  - Portion control
- Patients desiring flexibility

Basic CHO Counting

- Based on amount of CHO from each exchange
  - CHO serving = 1 starch = 1 milk = 1 fruit
  - RD determines # of CHO choices per meal

- "I have x amount of CHO choices at breakfast, lunch, etc.

Factors to Consider

- Numeracy and Literacy
- Carbohydrate Insulin Ratio (on Insulin)
- Insulin Sensitivity
- Insulin Resistance
- Target Blood Glucose
- Glycemic Index and Macronutrient Content

Insulin Absorption

- Variation in absorption up to 20% to 30% for regular insulin
- Long-acting variation greatest variability
- Analogs have less variable
- Site of injection - abdomen the best
- Other factors effect absorption- heat, massage, hot showers and exercise

Insulin On Board

Insulin left after bolus-depends on insulin type

- Kinetic time = insulin disappears
- Dynamic action- time in system to ↓ BG (IOB)
- Depends on patient

Factors affecting IOB

- Large bolus may delay insulin action
- Exercise ↑absorption and ↓duration
- Temperature- increase with hot weather

Glycemic Response of Foods

- Fruit ½ hour
- Starch 1-1/2 hours
- High fiber starch food 2-1/2 hours
- Protein 2-5 hours
- Fats/oils 4-6 hours

Macronutrient Effects- Protein

- Rate of digestion and conversion to glucose dependent on insulinization and glycemic control
- BG effect difficult to predict
  - Up to 50% be converted to glucose
- Evidence indicates more glycemic effect with poor control
  - Better control and adequate insulin levels less impact

Macronutrient Effects Protein

- How to manage
  - Small to moderate protein little effect on BG
  - Large protein (> 8 oz)
    - BG may increase 4-12 hours later
    - Split bolus beneficial
    - Duration and dosage individualized

Macronutrient Effects- Fat

- Effects on BG
  - Delayed stomach emptying
  - May last or delay response for hours after eating
- Less than 10 % converted to glucose
- Individual's response needs to be evaluated

Vegetarian Diet: Is There a Place?

Protein Sources and Carbohydrate

Food Item	Quantity	Carbohydrate Content	Protein Content	Fiber Content
Beans (kidney)	½ cup	19 grams	9 grams	6 grams
Sunburgers	1 burger	19 grams	10 grams	8 grams
Seitan (Westsoy)	1/3 cup 2-3 ounces	4 grams	21 grams	1 gram
Tofu (House Foods)	3 ounces	2 grams	8 grams	2 grams
Tempeh (Lightlife)	4 ounces	16 grams	20 grams	11 grams
Quinoa	1 cup (cooked)	39 grams	8 grams	5 grams
Peanut Butter (Natural)	2 tablespoons	6 grams	9 grams	2 grams

Glycemic Index for Fine Tuning Blood Glucose Levels and Management

Glycemic Index (GI)

- May be of benefit to “fine tune” blood glucose levels

- Brand-Miller et al. conducted a meta-analysis of the GI in persons with type 1 and type 2 diabetes
  - Implementing a low–glycemic index diet lowered A1C values by 0.43% when compared with a high–glycemic index diet

Brand-Miller J, Hayne S, Petocz P, Colagiuri S: Low-glycemic index diets in the management of diabetes: a meta-analysis of randomized controlled trials. Diabetes Care 26:2261–2267, 2003

Glycemic Index (GI)

Intrinsic factors of a food can influence its impact on blood glucose

- Physical form of the food
- Ripeness
- Degree of processing
- Type of starch (i.e., amylose versus amylopectin)
- Style of preparation
- Specific type (e.g., fettucine versus macaroni) or variety (e.g., long grain versus white) of the food

Glycemic Index (GI)

Extrinsic factors

- Coingestion of protein and fat
- Prior food intake
- Fasting or pre-prandial glucose level
- Degree of insulin resistance
- Autonomic dysfunction (gastric emptying)

Brand-Miller J, Hayne S, Petocz P, Colagiuri S: Low-glycemic index diets in the management of diabetes: a meta-analysis of randomized controlled trials. *Diabetes Care* 26:2261–2267, 2003

Monitoring and Therapeutic Targets

A1C- reflects mean glucose over 2 to 3 months

- Goal: 6.5% > but < 8.0%
- Recommended frequency of testing
  - With values at target—every 6 months
  - When not at target or when treatment changes—every 3 months

Cardiovascular Risk in Diabetes

- Treatment target: BP <130/80 mm Hg
- Treatment target: LDL <100 mg/dL (70 mg/dL preferred)
- Treatment target triglycerides target: <150 mg/dL

American Diabetes Association. Diabetes Care-,Standards of Care 2014

Summary

- MNT approach may vary over time
- Medical management becomes more/less complex
- Individualize approach and consider
  - Type of diabetes
  - Stage of kidney disease
  - Diabetes “burnout”
  - Polypharmacy
  - Food Access
  - Support system