Diabetes and Dialysis: Does the Dietitian Have a Responsibility?

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Objectives

- Identify why and how the dietitian has a responsibility to integrate care for diabetes per Measurement Assessment Tool (MAT)
- Describe the impact diabetes and dialysis can have on one another
- Summarize the nutritional considerations for those who have diabetes and receive dialysis
- Delineate how diabetes influences outcome goals regarding fluid and electrolyte balance, nutritional status, and mineral bone disease

Criteria for Diagnosis of Diabetes (DM)*

- A1C ≥ 6.5% (NEW)

OR

- FPG ≥ 126 mg/dl

OR

- 2-hr plasma glucose ≥ 200 mg/dl during an OGTT

OR

- Random glucose ≥ 200 mg/dl in a patient with classic symptoms of hyperglycemia

* Diabetes Care 2010;33(S1):S62-S69

Changing Image of DM and CKD5

Type 1

Type 2

Diabesity

Diabetes and ESRD Statistics in New Jersey

- 2012 State Prevalence of DM*
  - 9.2%
- 2014 New Incidence ESRD Patients
  - 3554 Total
  - 39.3% Female
  - 60.7% Male
  - 42.7% DM
- 2014 Prevalent ESRD Patients
  - 13,093 Total
  - 41.2% DM

*http://www.state.nj.us/health/chs/hnj2020/chronic/diabetes/

Insulin Resistance (IR) and Pre-Diabetes

- IR: not commonly labeled in renal literature as pre-diabetes.
- Increased risk for developing diabetes:*
  - Impaired fasting glucose, fasting plasma glucose: 100-125 mg/dl
  - Impaired glucose tolerance, 2-hr 75 gm OGTT: 140-199 mg/dl
  - A1c 5.7 - 6.4% (NEW)

*Diabetes Care 2010;33(S1):S62-S69

Insulin Resistance in CKD

- Impaired tissue sensitivity to insulin occurs in almost all uremic patients and is largely responsible for the abnormal glucose metabolism seen in this setting
- Possible mechanisms (although pathogenesis and exact site have not been fully elucidated):
  - ↑ hepatic gluconeogenesis that does not suppress normally following insulin
  - ↓ hepatic &/or skeletal muscle glucose uptake
  - Impaired intracellular glucose metabolism
  - Increasing evidence for an important role of PTH and Vitamin D
  - Metabolic acidosis can suppress insulin release

Insulin Resistance and CKD

- IR is an independent predictor of cardiovascular mortality in non-diabetic ESRD pts
- Mild glucose elevations may precede dyslipidemia
- Early intervention warranted re: lifestyle including diet and exercise
  - Potential development of DM with PD, especially if family h/o DM
  - Obesity: BMI ≤35 often desired pre-transplant
  - Likely development of new onset DM after transplantation, >40% incidence by end of 3rd year

§ 405.2163 Condition: Minimal service requirements for a renal dialysis facility or renal dialysis center. Link to an amendment published at 73 FR 20474, Apr. 15, 2008.

(d) *Standard: Dietetic services.* Each patient is evaluated as to his nutritional needs by the attending physician and by a qualified dietician (§ 405.2102) who has an employment or contractual relationship with the facility. The dietician, in consultation with the attending physician, is responsible for assessing the nutritional and dietetic needs of each patient, recommending therapeutic diets, counseling patients and their families on prescribed diets, and monitoring adherence and response to diets.

https://www.gpo.gov/fdsys/pkg/CFR-2008-title42-vol2/xml/CFR-2008-title42-vol2-sec405-2163.xml

Diabetes & Dialysis

- New dialysis pts with DM are more likely to have past history of CVD
- Poor glycemic control upon initiation of HD indicates worse survival
- Survival with DM is better during initial 2-yr of PD
- PD may thus be used prior to transitioning to HD

- DM as primary diagnosis
  - Lowest survival rate
  - Poorest rehab potential
  - Highest incidence of hospitalization
    - Cardiovascular events
- Person could have other primary cause of CKD with co-existing DM
- Higher costs with DM

Tag 494.80 Patient Assessment: Measurements Assessment Tool (MAT)

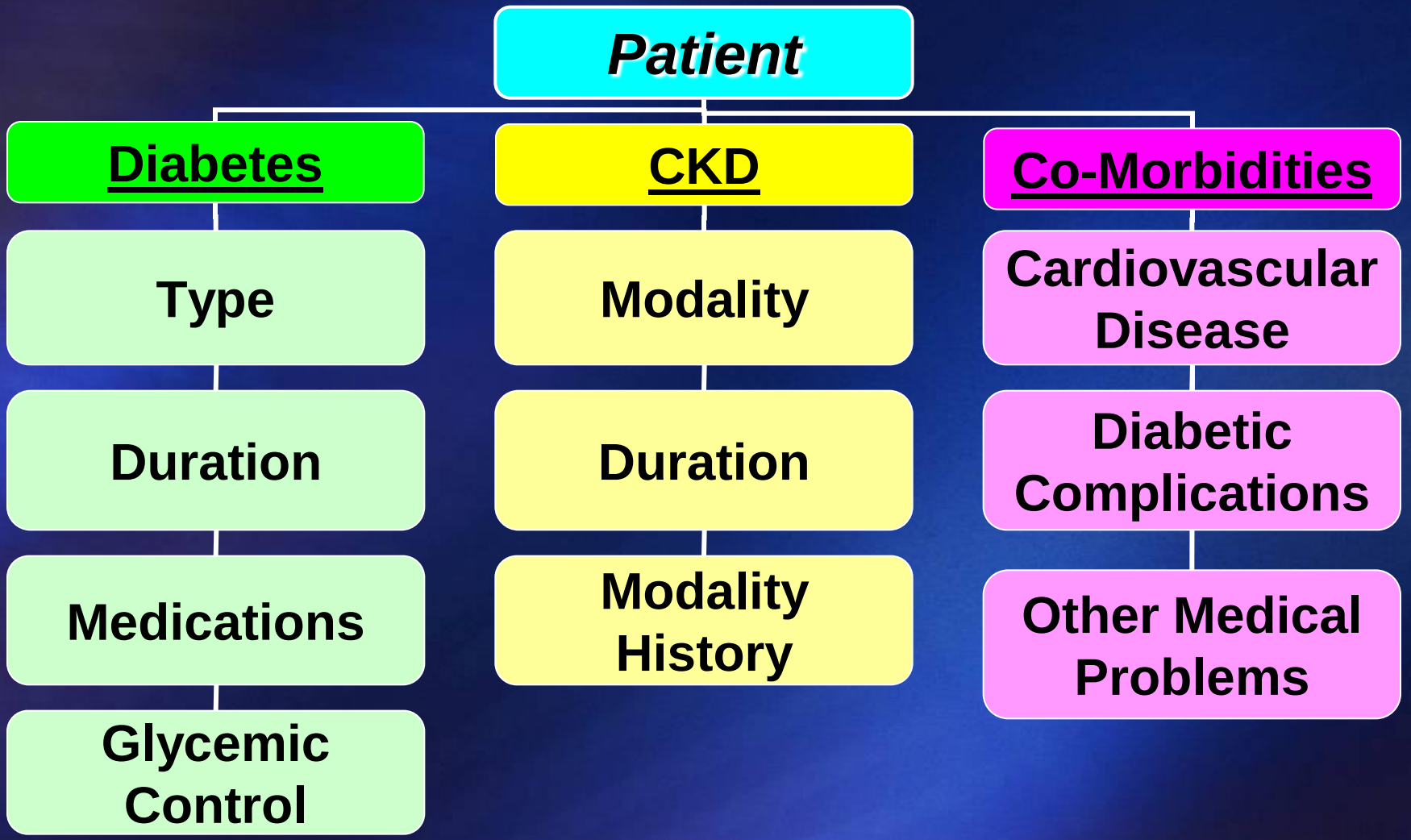
The interdisciplinary team (IDT), patient / designee, RN, MSW, RD, physician must provide each patient with an individualized & comprehensive assessment of needs.

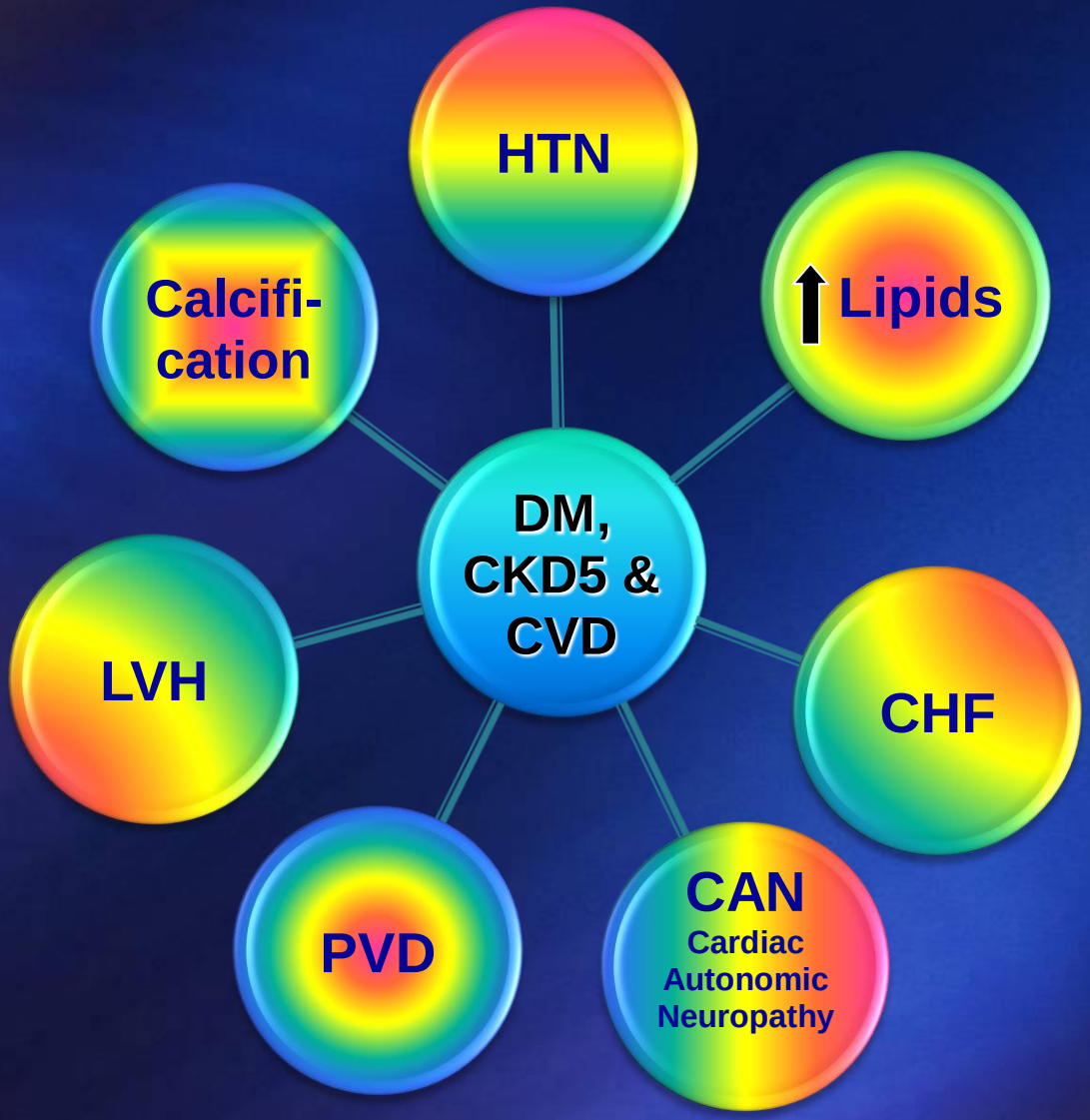
- V502: Health status/co-morbidities
- V503: Dialysis prescription
- V504: BP & fluid management
- V505: Lab profile
- V506: Immunization & meds history
- V507: Anemia

yellow indicates where diabetes may have additional importance for RD

Patient Assessment MAT cont.

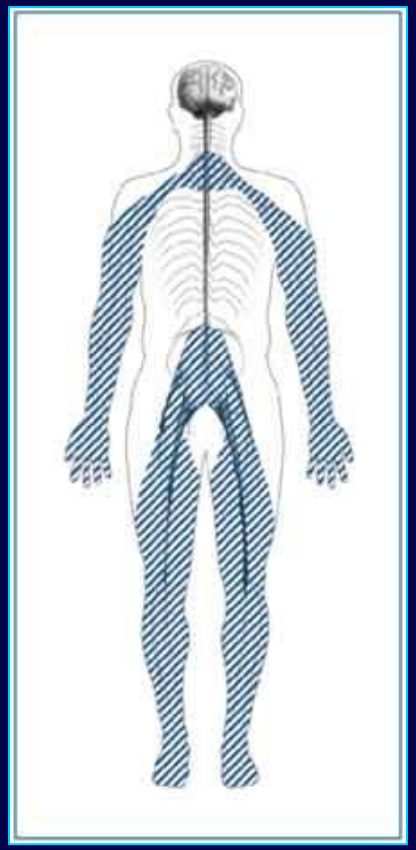
- V508: Renal bone disease
- V509: Nutritional status
- V510: Psychosocial needs
- V511: Dialysis access type & maintenance
- V512: Abilities, interests, preferences, goals, desired participation in care, preferred modality & setting, expectations for outcomes
- V513: Suitability for transplant referral
- V514: Family and other support systems
- V515: Current physical activity level & referral to vocational & physical rehab


Patient
Diabetes
Type
Duration
Medications
Glycemic Control
CKD
Modality
Duration
Modality History
Co-Morbidities
Cardiovascular Disease
Diabetic Complications
Other Medical Problems


HTN
Calcifi-
cation
Lipids
DM,
CKD5 &
CVD
LVH
CHF
PVD
CAN
Cardiac
Autonomic
Neuropathy

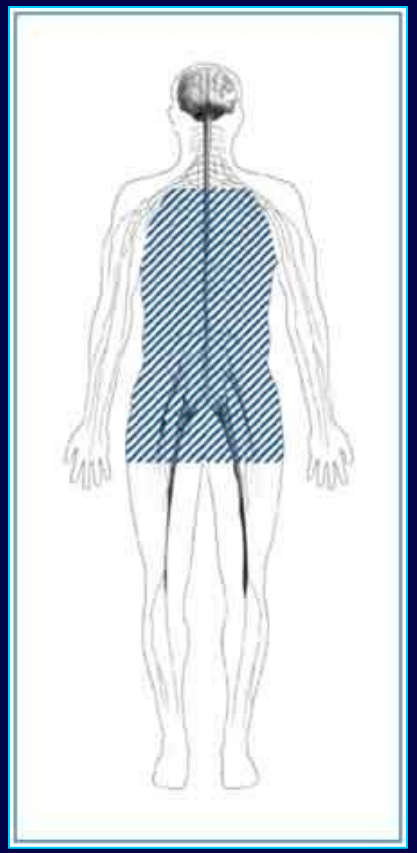
Neuropathy

Peripheral



Multiple Organ Systems Are Affected!

Autonomic



Nutrition Assessment

- Ht (noting amputations, if any) and wt (usual and present wt, stability of wt, comparison to reference wts)
- Volume and/or hydration status
- Pertinent lab data
- Medications and use of prescribed/OTC nutritional, dietary, &/or herbal supplements
- Dietary interview and/or diary
- Factors and barriers that influence appetite and intake including ability to chew and swallow, GI problems, access to food, psychosocial factors

Nutrition Assessment cont.

- Assessment of appetite, adequacy of pt's caloric and protein intakes
- Assessment of nutritional status
- Previous nutrition education and response
- Address the need to modify other nutrients in pt's diet
- Self management skills
- Attitude towards nutrition, health, and disease state management
- Documentation of nutrition education, level of understanding, and ability/willingness of the pt and/or caregiver to implement the nutrition information provided

Tag 494.90 Plan of care: MAT

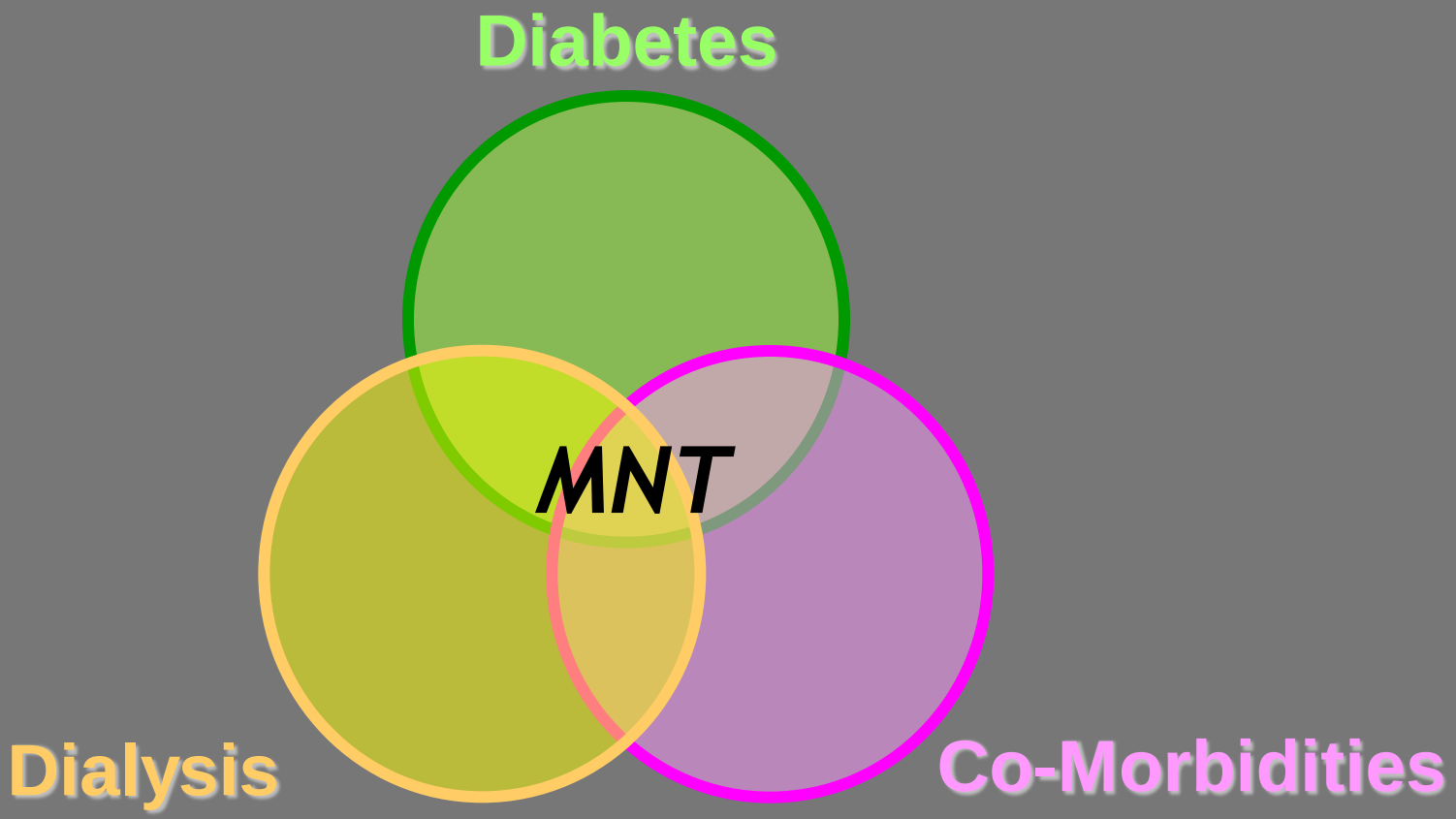
The IDT must develop & implement a written, individualized comprehensive plan of care that specifies the services necessary to address the patient's needs as identified by the comprehensive assessment & changes in the patient's condition, & must include measurable & expected outcomes & estimated timetables to achieve outcomes. Outcome goals must be consistent with current professionally accepted clinical practice standards.

Plan of Care: MAT cont.

- V543: Dose of dialysis/volume status
- V544: Dose of dialysis adequacy
- V545: Nutritional status – monitor albumin & body wt monthly; other parameters at V509, monitor as needed for impact on nutrition
- V546: Mineral metabolism & renal bone disease

Plan of Care: MAT cont.

- V547, V548, & V549: Anemia
- V550 & V551: Vascular access
- V552: Psychosocial status
- V553 & V554: Modality – home dialysis & transplant referral
- V555: Rehabilitation status
- V562: Patient education & training


Diabetes
MNT
Dialysis
Co-Morbidities

Monitoring and Education

Provide on-going monitoring of:

- subjective and objective data to determine the need for timely intervention and follow-up
- measurement criteria including but not limited to:
  - weight changes
  - lab data
  - adequacy of dialysis
  - medication changes which affect nutrition status and/or potentially cause adverse reactions and/or drug-nutrient interactions

Monitoring and Education cont.

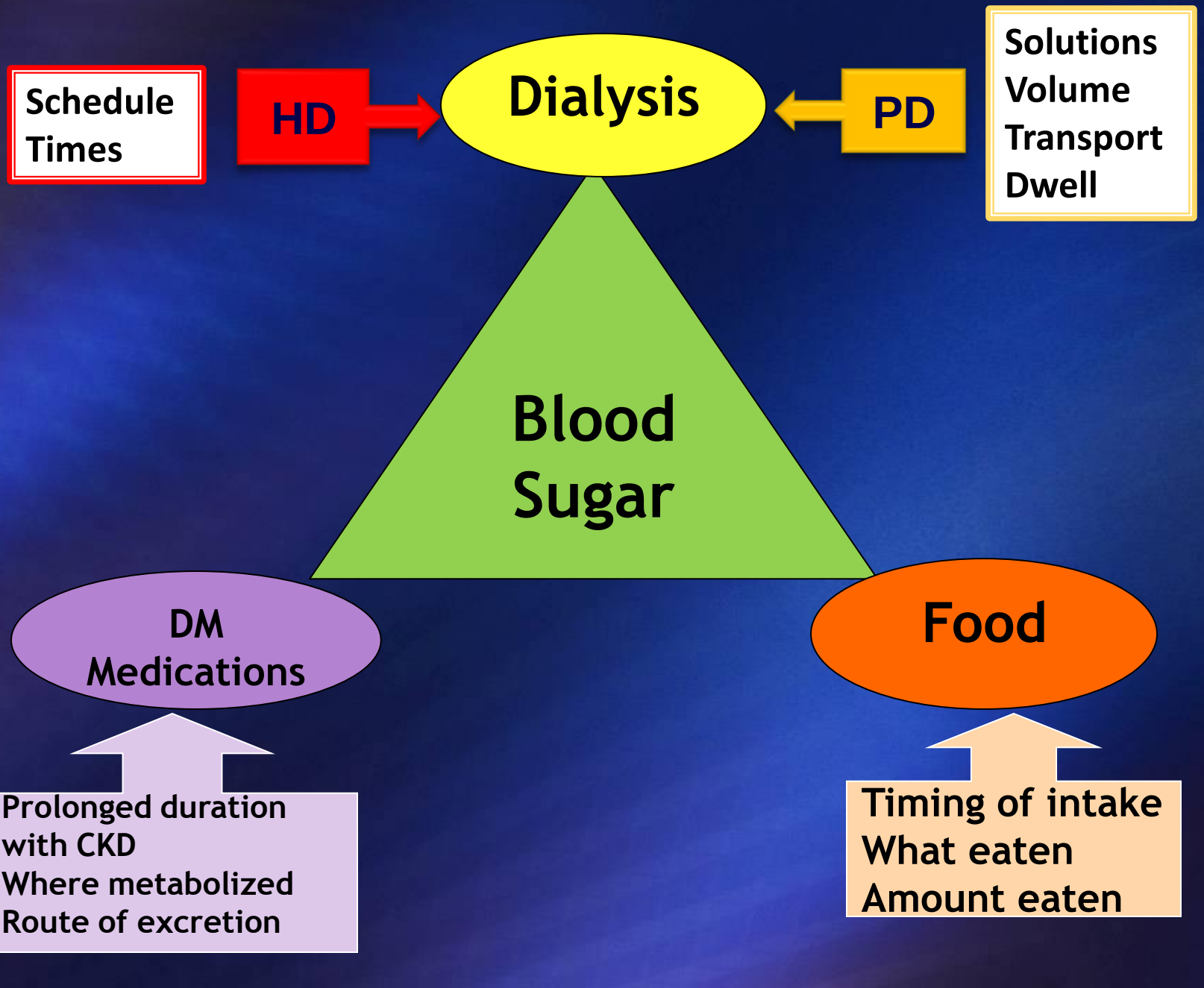
- Impact of hospitalization
- Co-morbidities that impact nutritional status
- Any specific nutrition related problems requiring assessment and referral for follow-up resources and/or community service
- Enteral and parenteral nutrition supplementation or routes
- Interface per need with caregivers including care facilities
- Education and response to such
- DOCUMENTATION

Education Considerations

- *Education is a Process* of helping a person find and learn how to use information and skills to understand their treatment and integrate self-care into their lives
- Do not assume that having long standing DM is synonymous with having a good understanding of DM and what glycemic control involves
- Dispel misconceptions
- Although there are renal diabetic food exchanges, the person should understand nutrition goals for DM and dialysis:
  - rationale
  - basic concepts
  - how they integrate

Glycemic Control and Dialysis

- Managing the challenges requires understanding the relationship between:
  - Hyperglycemia
  - Glycemic variability
  - Balancing the benefits with the risks
  - Combining antidiabetic agents safely and effectively to minimize complications
- GOAL – normalize glucose homeostasis


Schedule
Times
HD
Dialysis
PD
Solutions
Volume
Transport
Dwell
Blood
Sugar
DM
Medications
Food
Prolonged duration
with CKD
Where metabolized
Route of excretion
Timing of intake
What eaten
Amount eaten

Behavioral Factors: Glycemic Control & Dialysis

- Psychological: depression, helplessness, anger, stress, self efficacy
- Attitudes and Beliefs
- Family and Social Support
- Time Demands and Schedule
- Life Disruption
- Management and Organizational Skills
- Health Literacy and Numeracy
- Income and Insurance Constraints

Dealing with Two Chronic Diseases

Glycemic Control: ⬆ Risk for Hypoglycemia in CKD5

- ⬇ clearance of insulin and some of the oral agents with prolonged action, multifactoral
- diabetes medications aren't adjusted upon initiation of dialysis
- impaired kidney gluconeogenesis
- ⬇ in hepatic clearance of insulin, may improve after initiation of dialysis
- may be associated with hypotension during HD
- poor p.o. intake
- weight loss: makes body more sensitive to action of insulin

Glycemic Control: ⬆ Risk for Hypoglycemia in CKD5 cont.

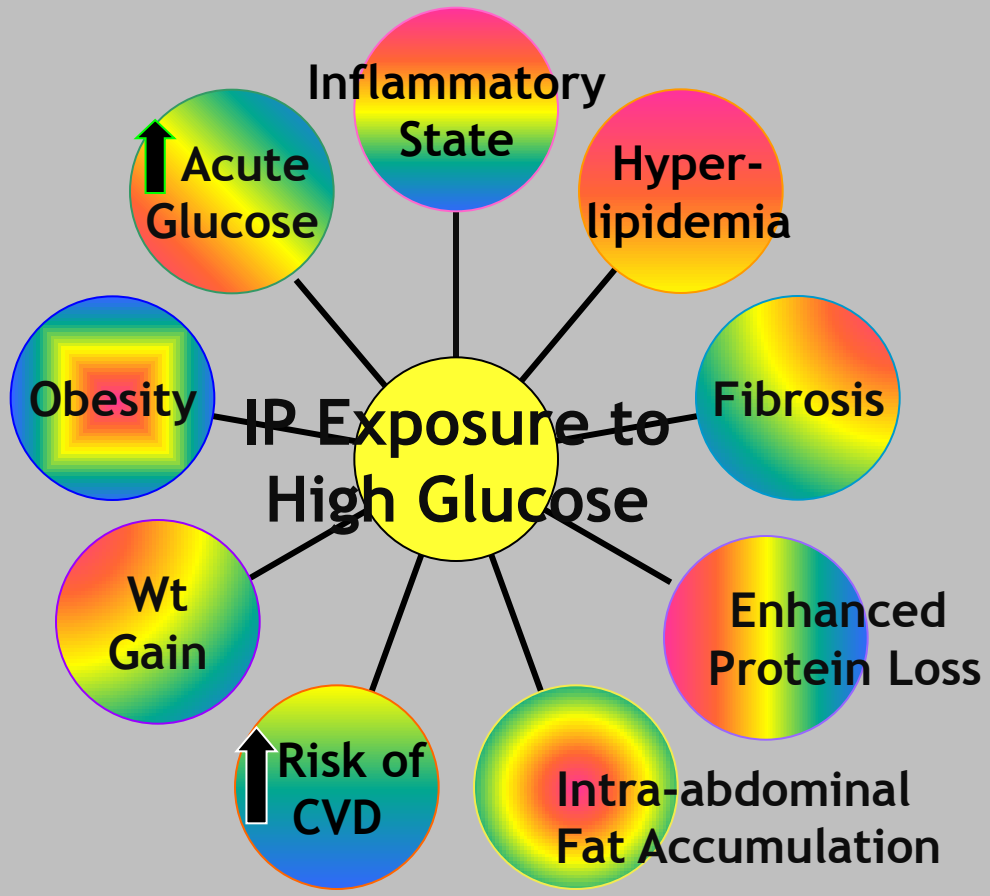
- ramifications of chronic malnutrition
- person trying to lose weight for transplantation may omit carbohydrates
- gastroparesis: the insulin acts before the carbohydrate portion of the meal is released into the intestine and absorbed
- alcohol consumption: can reduce the amount of glucose produced by the liver increasing risk for low blood sugar
- advanced age

Impact of HD Treatment on Glycemic Control

- 100 - 200 mg/dl glucose bath can alter blood sugar
- Possible increased risk of hypoglycemia up to 24 hrs after treatment
- Treatment schedule:
  - Interferes with usual meal time
  - Affects number of meals consumed
  - Patient alters insulin dosing times or omits insulin pre-HD for fear of hypoglycemia
- Post-treatment fatigue alters intake
- Transportation factors may compound issues
- Different eating and medication patterns on HD vs non-HD days

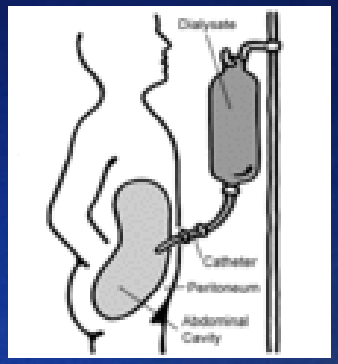
HD Treatment Issues Related to Diabetes

- Compromised adequacy due to:
  - Vascular access management related to PVD
  - Increased frequency of intradialytic hypotension related to
    1. Autonomic nervous system dysfunction
    2. Cardiac diastolic dysfunction
    3. Susceptibility to overhydration



PD: Underlying DM may compound or exacerbate these problems

Peritoneal Dialysis



- Effect of absorbed calories from dialysate
  - Include as part of total caloric intake
  - Impact on wt status
- Lack of hunger due to exposure to sugar
- Possible increase in adverse GI side effects
  - Negatively influence protein intake yet wt maintained
  - More GERD symptoms and eating dysfunction
  - Severe gastric emptying impairment may be present even with empty peritoneal cavity

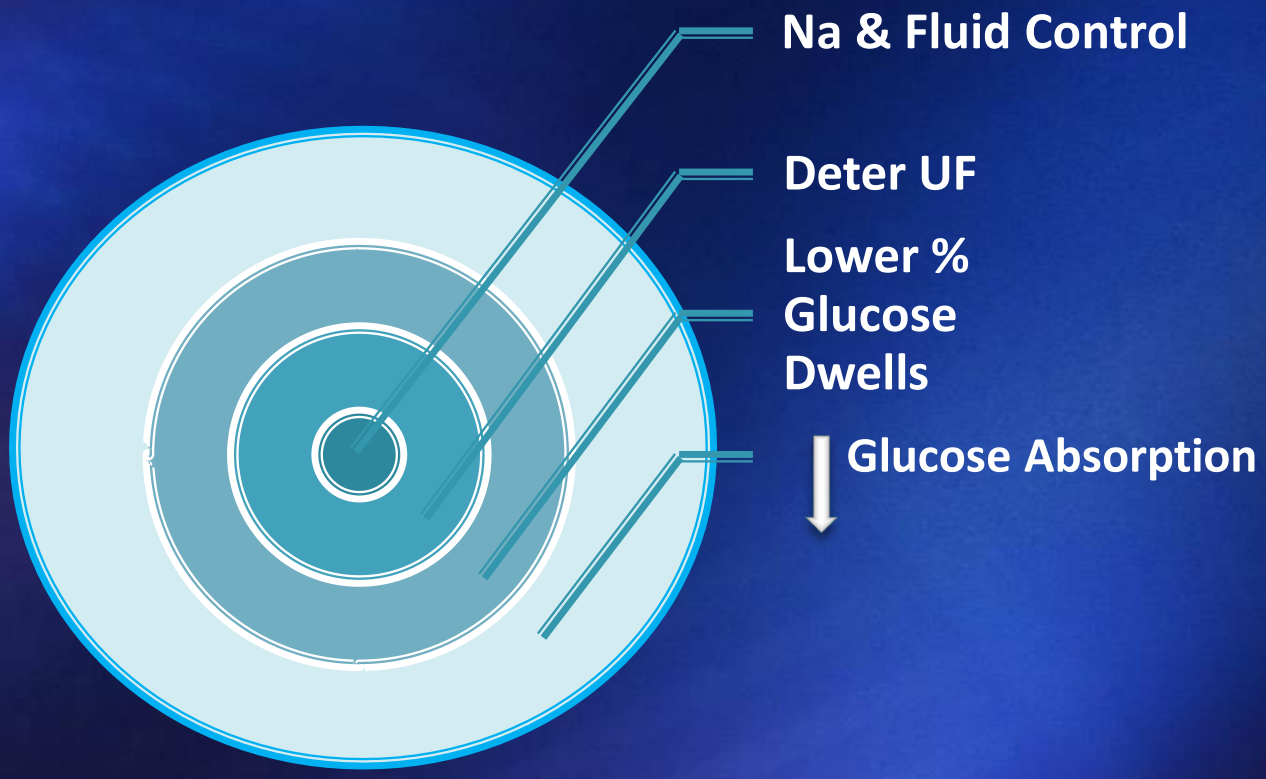
Glucose & Calories in PD Solutions

- 1.5% dextrose bags (yellow bags) = 15 g glucose/L*
- 2.5% dextrose bags (green bags) = 25 g glucose/L*
- 4.25% dextrose bags (red bags) = 42.5 g glucose/L*
- Absorbed calories need to be included as part of total energy intake
- *Simple Estimate for Daily Absorption:
  - Grams glucose infused based on total volume of exchanges utilized x 3.4 (est. kcal/g) x average absorption (40% CCPD/60% CAPD)

Ultrafiltration failure in PD develops from:

- Peritoneal fibrosis
- Increased membrane permeability
- Glucose directly or indirectly contributes to peritoneal membrane alteration via
  - Glucose degradation product generation: these compounds may be generated during the heat-sterilization of dialysis fluid
  - Advanced glycation end products (AGEs): proteins or lipids that become glycated after exposure to sugars. They affect extracellular and intracellular structure and function.

Glycemic Control with PD



PD: High Transporters

- Can have large glucose loads from rapid peritoneal glucose absorption
- Will benefit with transfer from CAPD to nocturnal PD
- Rapid glucose absorption lowers the osmotic gradient between dialysis and blood
  - ↓ ultrafiltration (UF) and urea removal →

  fluid retention
  - Vicious cycle develops from frequent use of higher % dialysate leading to further hyperglycemia

Berns, Glickman et al. uptodate.com 2015

Minimize Glucose Exposure: Icodextrin

- Icodextrin (maltose based) may provide better glycemic control
- 7.5% icodextrin (purple bags) = 75 g glucose/L
- CHO absorption is equivalent to a 2.5% dextrose bag but is associated with UF of a 4.25% dextrose bag
  - Approximately 20% of the total CHO is absorbed in 8 hrs & 34% in 12 hrs. Mean CHO absorption is 29.5 ± 5g vs 62 ± 5g for 4.25% gluc solution per 12 hr dwell (Baxter Extraneal monograph).
- Used often as last fill option for daytime dwell in peritoneal cavity

Minimize Glucose Exposure: Icodextrin cont.

- Frequently prescribed for those who need more UF or are high transporters
- Increases UF volume
- Improves BP control
- Less hyperlipidemic
- Only glucose monitors and test strips that utilize glucose oxidase or hexokinase methods should be used. Refer to manufacturer guidelines.

Diet, Diabetes, and Dialysis

- Nutrition needs similar to those without DM per modality with extra emphasis on:
  - Achieving individualized glycemic goals
  - Minimizing dyslipidemia
  - Total energy appropriate to weight management goals
  - Considering age specific goals
- Unlikely one optimal mix of macronutrients exists
- Best mix of macronutrients varies per an individual's circumstances

American Diabetes Association Nutrition Recommendations

- CHO monitoring is essential to glycemic control.
- The amount of CHO & available insulin may be the most important factors influencing glycemic response after eating.
- Glycemic index & load may provide modest additional benefit.
- Total CHO intake ≤ 130 g/day is not recommended.
- Sucrose can be substituted for other CHO in meal plan but this may displace nutrient-dense food choices.

Additional Diet Considerations

- Limit or avoid intake of sugar sweetened beverages to ↓ risk of weight gain & worsening cardio-metabolic risk profile
- CHO and calorie content from natural sugars in fruit juices; encourage whole fruit
- Consistent CHO intake with respect to time and amount can result in improved glycemic control and reduced hypoglycemic risk for individuals using fixed daily insulin doses
- A simple DM meal planning approach, such as portion control or healthful food choices, may be better suited for individuals with health literacy and numeracy concerns or older adults

Additional Diet Considerations

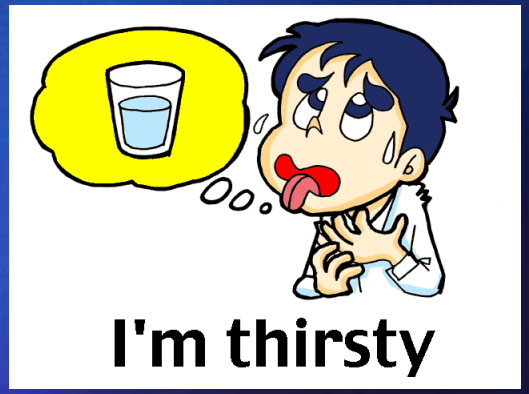
- Meal spacing and timing
  - Need to eat before and after HD treatment, if person is prone to hypoglycemia
  - Coordination with PD schedule and sugar influx as well as impact on GI symptoms
- Balancing CHO throughout the day
- Treatment for hypoglycemia (low K+ for HD)
- Sick day rules, CHO replacement
- Encourage fruits and vegetables that are rich in phytonutrients (low K+ for HD)
- PD: High K+, low CHO foods to deter hypokalemia
- Fiber intake goal: ≥14 g/1000 kcal

Volume Control Concerns with Diabetes

- Regulation of Na+ & fluid is essential to control IDWG and deter volume overload adversely impacting:
  - Cardiomyopathy
  - LVH
  - CHF
  - BP dynamics
    - HTN
    - Orthostatic hypotension
    - Intradialytic hypotension

Fluid Control and Diabetes

- DM: higher risk of greater fluid retention*
- Control may be more difficult with DM
  - Hyperglycemia can ⇑ thirst
  - Neuropathy
    - More prone to symptoms of dry mouth
    - ↓ salivary flow rates
    - Effects of xerogenic drugs
  - Dental problems
  - Gastroparesis



*Circulation 2009;119:67-69

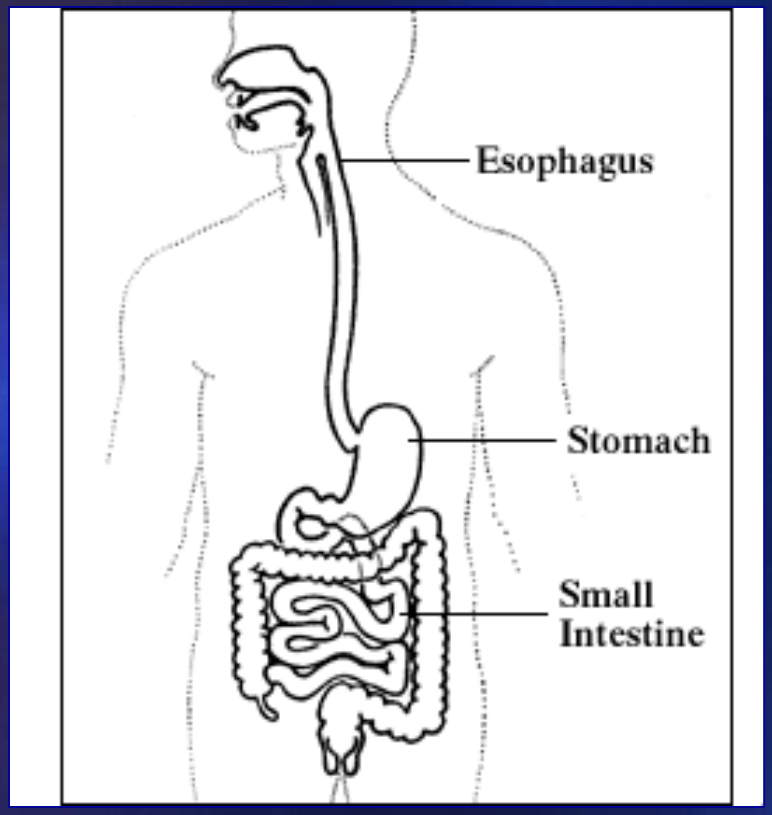
Fluid Issues Per Dialysis Modality

- HD
  - Stability is affected by removal of large fluid volumes
  - Fluid & electrolyte shift fluctuations contribute to CVD risk
  - Use of hypertonic during HD can cause post-treatment thirst
    - Practice of this has fallen out of favor in recent years
- PD
  - Increased fluid retention requires higher % dextrose for UF
    - Glucose absorption
    - TG production
    - Extra calories resulting in weight gain

Malnutrition & Hypoalbuminemia

- Micro- and macrovascular complications of DM impact on ADLs
  - Access to food supply
  - Food preparation ability
  - Impact on p.o. intake
- Gastrointestinal autonomic neuropathy
- Oral health
- Role of insulin in protein metabolism

Gastrointestinal Autonomic Neuropathy



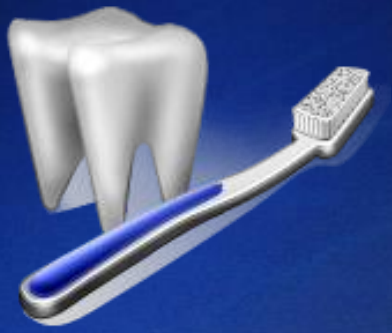
- Entire GI system can be involved
- Gastroparesis: 50% occurrence
- GERD: 30% occurrence
- Diabetic diarrhea: 20% occurrence
- Fecal incontinence
- Constipation

Metabolic Consequences of Gastroparesis

- Nutrient delivery to small bowel is impeded
- Meal related protein synthesis will probably be decreased
- Medication absorption is affected
- Gastroparesis complicates balancing insulin dosing and food absorption

Oral Health Issues

- Oral hygiene may be worse in HD population than in general population
- Hyposalivation associated with:
  - Elevated blood glucose
  - Diabetic neuropathy
  - Xerogenic drugs



- Periodontal gum disease may be due to prolonged hyperglycemia exposure
- Dental decay associated with diabetic nephropathy, although causes unclear
- **Malnutrition** is exacerbated by improperly fitting dentures, dental caries, missing teeth, and local infections
- Issues need treatment prior to transplantation as immunosuppressive protocols may further predispose oral and possibly disseminated infections.

Protein Metabolism and Diabetes

Role of insulin:

- ↑ rate of transport of some amino acids into tissues
- ↑ rate of protein synthesis in muscle, adipose tissue, liver, and other tissues
- ↓ rate of protein degradation in muscle
- Insulin deficiency is a protein catabolic state
- Once amino acids gain entry into liver, insulin inhibits conversion to glucose counteracting glucagon, thus performing a protein sparing mechanism
- In starvation or fasting, gluconeogenesis is derived from protein (175 g protein destroyed → 100 g glucose). Insulin inhibits this and performs the actions of a protein sparing mechanism.

Protein Metabolism in Type 2 Diabetes

Gougeon, Marliss et al. International J of Obesity (1998)22, 250-261:

- Insulin therapy can lower abnormally elevated nitrogen flux and protein breakdown in hyperglycemic subjects
- Magnitude of under insulinization causes alterations in the integrated daily protein metabolism
- “Protein metabolism is more sensitive to the state of diabetes control than is generally appreciated clinically”

Gougeon, Morais et al. Diabetes Care (2008)31:128-133:

- Protein flux, synthesis and breakdown are elevated while net balance is diminished
- Insulin sensitivity of protein metabolism is blunted
- There is a need to define protein requirements in relation to concurrent obesity, wt loss, and level of glycemic control

Insulin sensitivity of muscle protein metabolism is altered in CKD and metabolic acidosis*

- An emergent hypothesis is that a resistance to the anabolic drive by insulin may contribute to loss of strength and muscle mass in patients with CKD
- Acidemic CKD patients need higher than normal levels of insulin to inhibit proteolysis.
- Alterations of protein metabolism by insulin may lead to changes in body tissue composition, metabolic rates, and individual amino acid metabolic steps which may become clinically evident in conditions characterized by low insulinemia
- Preventing or treating muscle catabolism favored by insulin resistance may potentially prove to be a new target for the nutritional treatment of pts with CKD

*Garibotto, Sofia, et al . doi:10.1038/ki.2015.247

Hyperkalemia and Diabetes

- Excessive K+ intake
- Impaired renal excretion
- Disturbed cellular uptake of K+
  - Hyperosmolar states such as uncontrolled DM: water moves K+ from intracellular to extracellular fluid
  - Insulin deficiency or resistance – inability of insulin to promote K+ entry into cells
- Acidosis
- Constipation
- Medications: ACEi, ARBs, β-blockers, NSAIDs, Tacrolimus, Cyclosporine, some antibiotics

Hypokalemia and Diabetes

- Shift hypokalemia – too much insulin
- GI loss of K+
  - Malabsorption syndromes
  - Diabetic induced motility disorders
  - Bacterial overgrowth
  - Chronic diarrhea states
  - Side effect from medication such as antibiotic
  - Vomiting
  - Laxative abuse
  - Ostomy output

Mineral Bone Disease & Diabetes

- Type 1: ↓ bone mineral density
- Type 2: normal or ↑ bone mineral density
- DM may affect bone by multiple pathways.
- Adynamic bone disease – also linked to vascular calcification. Most often seen in elderly and with DM.
- Poor glycemic control is risk factor for osteoporosis as well as fractures.
- Hyperglycemia could have direct deleterious effect on bone cells. Osteoporosis Int (2006);17(7):986-995
- DM is associated with ↑ fracture risk; risk of hip fracture is 4x greater with dialysis. Propensity to fall & multiple co-morbidities may further explain the rate.

Mineral Bone Disease & Diabetes cont.

- ↑ bone fragility due to accumulation of advanced glycation end products within bone collagen causing stiffer collagen network and brittle fibers. Front Endocrinol 2013;4:72
- Massive cellular shifts of phosphate out of the cells is a rare cause of ↑ phos but has been documented with DKA or severe hyperglycemia alone. Uptodate.com
- Metabolic acidosis can diminish glycolysis and therefore cellular phosphate utilization resulting in hyperphosphatemia. Uptodate.com
- Gastric autonomic neuropathy: impact on phosphate binder absorption and timing with meals

Emphasizes need for maintaining metabolic parameters within goals to decrease risks.

What is the RD responsibility to patients with diabetes undergoing dialysis?

- Value our crucial role and perspective in dialysis
- Comprehend the magnitude of DM
- Medication familiarity
- Integrate MNT for two disease states
- Be a patient advocate
- Recommendations and referrals to other members of interdisciplinary team, endocrinologist, and/or community agencies

Ultimate Goal: Improve Person's Quality of Life

- Decrease fear of eating
- Lessen fear of hypoglycemia
- Minimize DM complications
- Diminish adverse treatment effects
- Better self care management providing sense of patient empowerment
- Lower hospitalization rate
- Greater sense of well-being

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