Nutritional Considerations of Diabetes Mellitus

Presented by:
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Diabetes Mellitus an American Epidemic
How big is the problem?

- ~18 million people in the US have diabetes mellitus.
- Dollar cost of treating DM and its complications has been estimated at $92 billion/year.
Diabetes Prevalence (age)

Centers For Disease Control

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Cost of Major Comorbidity

- In 1997, direct expenditures for health care services attributable to diabetes were estimated to be $44.1 billion in the United States.  
  (Diabetes Care – 1998)
  - 27% for chronic complications
    - Cardiovascular
    - Renal
    - Ophthalmic
- Annual management costs for people with diabetes are 1.5 to 2 times higher than those without diabetes.
Diabetes Mellitus

Statistics

- 90% are Type II
- 10% are Type I
Chronic Complications

- Small vessel diseases
- Large vessel diseases
- Susceptibility to infection
- Insulin shock
- Hyperglycemia reaction
Small Vessel Diseases

- Blindness – 25X
- Renal Disease – 17X
- Gangrene – 5X
- Heart disease and stroke – 4X
Diabetes and Blindness

- Each year, up to 24,000 people lose their sight because of diabetes.

DM Retinopathy  Normal Eye  Macular Degeneration
Diabetic Nephropathy

- ~ 80,000 individuals are diagnosed with renal failure per year in the US.
- Diabetes mellitus is the most common cause of kidney failure.
  - Approximately 40%-50% of new cases.
- Approximately 21% of all patients with diabetes develop kidney disease.
- Approximately 100,000 people have kidney failure as a result of diabetes.
- Approximately 40% with Type 1 DM develop nephropathy and renal failure by the age of 50. Some develop prior to 30 years of age.
- NIDDM – at least 5-20% have renal disease 20 years after diagnosis.
Primary Diagnosis for Kidney Failure

- Diabetes: 43%
- HTN: 23%
- CGN: 19%
- PCKD: 3%
- Other: 12%

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GFR

- Evaluation and treatment should begin in type 2 diabetes mellitus individuals with a GFR of less than 60, regardless of whether they have retinopathy or proteinuria.

(JAMA – 7/2003)
Kidney Disease Screening

- Current kidney-disease screening techniques for people with type 2 diabetes mellitus miss up to 30 percent of cases.

JAMA - 6/2003
Diabetic Neuropathy

- **Peripheral neuropathy**
  - Feet and hands

- **Autonomic Neuropathy**
  - Cardiovascular – hypotension and ischemic.
  - Sexual – impotence
  - Gastrointestinal
    - Nausea
    - Esophagitis
    - Diarrhea or constipation
    - Gastroparesis – affects 25%
    - Bloating
Vitamins and Nutrients

Associated with Diabetic Mellitus…
Thiamin

- May prevent and decrease neuropathy.
- Required for the synthesis of acetylcholine.
- Pyruvate dehydrogenase (B1 dependent enzyme).
- Synergistic with magnesium.
- Requirement increases with CHO intake.
- Deficiency may increase incidence of nephropathy.
Riboflavin

- Diabetics have abnormal riboflavin metabolism.
- Riboflavin 5’ Phosphate form is recommended.
- Required for the synthesis of glutathione.
Niacin (Nicotinamide)

- Acts by protecting pancreatic B-cells from autoimmune destruction by maintaining intracellular NAD levels and inhibiting the enzyme (ADP-ribose) polymerase (PARP).
  - Enzyme involved in DNA repair
- May act as a weak antioxidant of nitric oxide radicals.
- Component of GTF.
- May retard the development of nephropathy.
- Dosage: 25-50 mg/kg/day.
Pantethine

- Lowers blood cholesterol
- May prevent neuropathy
Pyridoxine

- Dosage: 100 mg/day

- Decreased serum pyridoxal concentrations have been found with DM patients suffering with neuropathy.

- May prevent and decrease retinopathy.

- Shown to decrease inflammatory markers in arthritis.

(EJCN-2010)
Vitamin B-12

- Dosage: 500 - 1000 ug/day
- May benefit neuropathy.
- Lowers Homocysteine
- Glucophage (Metformin) has been shown to reduce B12 absorption and increase homocysteine.
Folate

- Lowers Homocysteine
  - May prevent retinopathy
  - May prevent nephropathy

- Glucophage (Metformin) has been shown to lower folate levels can increase homocysteine.
Vitamin C

- **Dosage**: 2 gm/day
- Prevents protein glycosylation
- **Antioxidant**
- **Aldose reductase inhibitor**
- May prevent microangiopathy
- Decreased leukocyte concentration
- Low insulin levels with hyperglycemia accelerate the cellular changes leading to atherosclerosis
Vitamin E

- Prevents protein glycosylation
- Antioxidant
- Reduces LDL oxidation
- Inhibits platelet adhesion and aggregation
Chromium

Action:

- Increasing the activation of Akt phosphorylation
  - Intracellular insulin-dependent protein that facilitates the uptake of glucose into cells.
- Increase in the number of insulin receptors.
- Increases activation of the insulin receptor in the presence of insulin.
- May reduce insulin requirement.
- HbA1c (decreases have been similar to those seen with many oral hypoglycemic agents.)
- Has shown to improve dyslipidemia in some diabetics.
- Positive effects should be seen in 6 – 12 weeks.
Chromium – Adverse effects

- Renal and hepatic toxicity
- Rhabdomyolysis
- Psychiatric disturbances
- Hypoglycemia
- Nutrient vs Nutrient
  - Decrease zinc absorption
  - Competes with iron for transport on transferrin
  - Vitamin C and aspirin may increase absorption
Type 2 Diabetes Mellitus

- Characterized by cellular and extracellular Mg depletion.

- Epidemiological studies
  - High prevalence of hypomagnesaemia and lower intracellular magnesium.
Magnesium and Insulin

**Intracellular magnesium**
- Key role in regulating insulin action (mainly oxidative glucose metabolism).
- Insulin-mediated-glucose uptake.
- Vascular tone.
- Reduced concentrations.
  - Result in defective tyrosine-kinase activity at the insulin receptor level.
    - Post binding
    - Influencing intracellular signaling and processing
  - Post-receptorial impairment in insulin action
  - Worsening of insulin resistance.

(Arch Biochem Biophys June,2006)
Magnesium

- Dosage: 400 - 600 mg/day
- Low in Diabetes, especially with proliferative retinopathy.
- Intracellular magnesium levels were lower in patients with neuropathy.
- Important cofactor in glycolysis.
- This nutrient helps to prevent calcification of blood vessels.
- Helps control lipids in blood.
- Elevated glucose levels increase excretion and utilization.
- Prevents platelet aggregation.
Magnesium

- Evidence-based research

- **Glycemic control** – An inverse relationship between plasma magnesium levels and indices of glycemic control in both Type 1 and 2.

- **Insulin sensitivity** – diets low in magnesium are associated with increased insulin levels, and clinical magnesium deficiency is strongly associated with insulin resistance.
Zinc

- Alters fat and carbohydrate metabolism.
- Diabetics tend to hyperexcrete zinc.
- Important in wound healing.
- May protect beta-cells.
Vitamin D

- Has been associated with Type I and Type II Diabetes Mellitus.
- Living at higher latitudes is associated with an increased risk of type 1 diabetes.
- Children who received 2000 IU vitamin D/d during the first year of life and who were followed for 31 y were found to have a reduced risk of developing type I diabetes by 78% compared with children who were not supplemented with vitamin D. (Lancet 2001)
- Essential for normal insulin release by increasing transmembrane calcium movement in islet cells.
  - Vitamin D-dependent calcium binding protein has been detected in pancreatic tissue.
  - Vitamin D receptors have been identified in pancreatic islets. (J Endocrinol Invest 1988)
Quercetin

- Aldose reductase inhibitor
- Antioxidant
- Protects Vitamin C
Alpha Lipoic Acid

- Prevents protein glycosylation
- Antioxidant
- Stimulates glucose uptake by muscle cells.
Coenzyme Q10

- Lipid-soluble molecule derived mainly from endogenous synthesis.
- Can lower BP (100-120 mg/d).
- Higher serum CoQ levels have been associated with lower HbA1c.
- Has not been found to improve FBG or insulin concentrations.
- Found to be low in diabetics.
- May prevent nephropathy.
- May prevent & decrease neuropathy.
- Antioxidant
  - May reduce oxidative stress by inhibiting the generation of superoxide by mitochondria. (controversial)
Inositol

- Restores intracellular inositol
- May prevent &/or decrease neuropathy
Omega-3 Fatty acids

- Decrease the risk of cardiac arrhythmias
- Decrease blood clot formation
- Decrease heart attacks
- Decrease strokes
Iron and Diabetes Mellitus

- Consuming a lot of iron from red meat (heme) appears to increase the risk of diabetes mellitus.

(AJCN-1/2004)
Alcohol and Diabetes Mellitus

- Alcohol cannot be converted to glucose.
- Blocks gluconeogenesis.
- Increases the effects of insulin by interfering with the counterregulation response to insulin-induced hypoglycemia.
Please join us next month, Thursday September 16th, for our webinar on, “Nutritional Considerations of Skin Disorders.”

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For a one-on-one consultation with Dr. Grabowski please email webinar@spectracell.com to set up an appointment.