Chapter 31

MEDICAL NUTRITION THERAPY FOR DIABETES MELLITUS AND HYPOGLYCEMIA OF NONDIABETIC ORIGIN
Objectives

- Diabetes Mellitus
  - Type 1 (formerly IDDM, type I)
  - Type 2 (formerly NIDDM, type II)
  - Gestational diabetes mellitus (GDM)
  - Prediabetes (impaired glucose homeostasis)
- Risk factors
- Diagnosis
- Treatment/Management (MNT, drugs)
- Hypoglycemia of Nondiabetic Origin
Intervention: Diet Planning for Pts with DM

The Nutrition Care Process and Model

Screening & Referral System
- Identify risk factors
- Use appropriate tools and methods
- Involve interdisciplinary collaboration

Practice Settings
- Codes of Ethics
- Dietetics Knowledge

Nutrition Assessment & Re-assessment
- Collect timely & appropriate data
- Analyze/interpret with evidence-based standards
- Document

Nutrition Diagnosis
- Identify & label problem
- Determine cause/contributing risk factors
- Cluster signs/symptoms/defining characteristics
- Document

Nutrition Monitoring & Evaluation
- Monitor progress
- Measure outcome indicators
- Evaluate outcomes
- Document

Nutrition Intervention
- Plan nutrition intervention
- Formulate goals & determine a plan of action
- Implement nutrition intervention
- Care is delivered & actions are carried out
- Document

Relationship Between Patient/Client/Group & Dietetics Professional

Outcomes Management System
- Monitor the success of the Nutrition Care Process implementation
- Evaluate the impact with aggregate data
- Identify and analyze causes of less than optimal performance and outcomes
- Refine the use of the Nutrition Care Process

Diabetes: Greek for “go through” (polyuria)

**Mellitus**
- Disorder of CHO metabolism

**Insipidus**
- Rare
- Body can't regulate how it handles fluids

**Symptoms**
- Extreme thirst
- Excretion of an excessive amount of diluted urine

**Causes:**
- Damage to the pituitary gland or hypothalamus (surg, tumor illness, genetic) affecting storage and release of ADH
- Defect in kidney tubules - don’t respond appropriately to ADH
Prediabetes (Impaired Glucose Homeostasis)

Two forms; may have either or both

- Impaired fasting glucose (IFG): fasting plasma glucose (FPG) above normal
- Impaired glucose tolerance (IGT): plasma glucose elevated after 75-g glucose load
- Hgb A1C 5.7%-6.4%
Type 1 Diabetes

Two forms

1. Immune mediated: beta cells destroyed by autoimmune process
2. Idiopathic: cause of beta cell function loss unknown

• Symptoms: hyperglycemia, polyuria, polydipsia, weight loss, dehydration, electrolyte disturbance, and ketoacidosis

• 5% to 10% of all diagnosed diabetes
Type 1 Diabetes

- Many patients are asymptomatic for years as beta cells are gradually destroyed over time
- Most cases are diagnosed <30yo
- The clinical onset can be abrupt but the pathophysiologic insult is a slow process
- Hyperglycemia is seen after >90% beta cell destruction
- Within 5-10 years of clinical onset all insulin production has stopped and there are no circulating antibodies.
Type 2 Diabetes

- Most common form of diabetes, accounting for 90% to 95% of diagnosed cases
- Combination of insulin resistance and beta cell failure (insulin deficiency)
- Progressive disease: hyperglycemia develops gradually and may not cause the classic symptoms of type 1 diabetes
Type 2 Diabetes

- Characterized by a combination of insulin resistance and beta cell failure
- Endogenous insulin levels may be low, normal or elevated but combined with insulin resistance resulting in hyperglycemia
- Making everything worse is glucotoxicity: the deleterious effect of hyperglycemia.
  - Glucose, the main regulator of insulin secretion and production, exerts negative effects on beta-cells when present in excessive amounts over a prolonged period include,
    - Reduced response to insulin-secreting stimuli
- Insulin resistance appears at the adipocyte level too—hyperglycemia results in lipolysis and an elevation of free fatty acids—this is made worse in patients with central adiposity.
- Lipotoxicity: Increased fatty acids cause a further decrease in insulin sensitivity and augment hepatic glucose production
Gestational Diabetes Mellitus

- Glucose intolerance with onset or first recognition during pregnancy
- Occurs in about 7% of pregnancies
- Women with GDM have a 40% to 60% chance of developing diabetes over the next 5 to 10 years
- Testing guidelines:
  - High risk (A1C > 6.5%, FBG >126mg/dL)- tested in first trimester
  - Normal risk- tested between 24-28 weeks
OGTT: 75g glu- one hour later BG is tested
  - GDM if >180mg/dL after one hour or >153mg/dL after 2h
Treatment is essential for health of baby
Risk Factors for Type 2 Diabetes

- BMI >25
- Physical inactivity
- High-risk ethnic groups (African American, Latino, Native American, Asian America, Pacific Islander)
- Previous delivery of baby >9 lbs or GDM
- Hypertension
- HDL <35 mg/dL or triglycerides >250 mg/dL
- PCOS
## Methods of Diagnosis

1. Fasting plasma glucose (FPG)
2. Casual plasma glucose (any time of day)
3. Oral glucose tolerance test (OGTT)

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Diabetes</strong></td>
<td>FPG $³126$ mg/dL</td>
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<tr>
<td></td>
<td>CPG $³200$ mg/dL plus symptoms</td>
</tr>
<tr>
<td></td>
<td>2hPG $³200$ mg/dL</td>
</tr>
<tr>
<td><strong>Prediabetes</strong></td>
<td></td>
</tr>
<tr>
<td>Impaired fasting glucose</td>
<td>FPG 100–125 mg/dL</td>
</tr>
<tr>
<td>Impaired glucose tolerance</td>
<td>2hPG 140–199 mg/dL</td>
</tr>
<tr>
<td><strong>Normal</strong></td>
<td>FPG &lt;100 mg/dL</td>
</tr>
<tr>
<td></td>
<td>2hPG &lt;140 mg/dL</td>
</tr>
</tbody>
</table>


CPG, Casual plasma glucose; FPG, fasting plasma glucose; 2hPG, 2-hour plasma glucose level (measured 2 hours after an oral glucose tolerance test with administration of 75 g of glucose).
Management of Prediabetes

- **Lifestyle change**
  - Increase physical activity
  - Moderate weight loss
  - Education
  - Reduced fat and energy intake
  - Regular participant follow-up
  - Whole grains and dietary fiber
Management of Diabetes

- Trials – Best Practice
  - Diabetes and Control and Complications Trial (DCCT)
  - United Kingdom Prospective Diabetes Study (UKPDS)

- Management
  - Medical nutrition therapy
  - Physical activity
  - Monitoring (BG)
  - Medications
  - Self-management education
# Diabetes: Treatment Goals

## Recommendations for Glycemic Control for Adults With Diabetes

<table>
<thead>
<tr>
<th>Glycemic Control</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1C</td>
<td>&lt;7.0%*</td>
</tr>
<tr>
<td>Preprandial capillary plasma glucose</td>
<td>90–130 mg/dL (5.0-7.2 mmol/L)</td>
</tr>
<tr>
<td>Peak postprandial capillary plasma glucose†</td>
<td>&lt;180 mg/dL (&lt;10.0 mmol/L)</td>
</tr>
</tbody>
</table>


*Referenced to a nondiabetic range of 4%-6% using a DCCT-based assay.

†Peak levels in patients with diabetes.
# Diabetes: Treatment Goals

## Recommendations for Lipid and Blood Pressure for Adults With Diabetes

<table>
<thead>
<tr>
<th>Lipids</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>LDL cholesterol</td>
<td>&lt;100 mg/dL (&lt;2.6 mmol/L)</td>
</tr>
<tr>
<td>HDL cholesterol</td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>&gt;40 mg/dL (&gt;1.1 mmol/L)</td>
</tr>
<tr>
<td>Women</td>
<td>&gt;50 mg/dL (&gt;1.4 mmol/L)</td>
</tr>
<tr>
<td>Triglycerides</td>
<td>&lt;150 mg/dL (&lt;1.7 mmol/L)</td>
</tr>
<tr>
<td>Blood Pressure</td>
<td>&lt;130/80 mm Hg</td>
</tr>
</tbody>
</table>


HDL, high-density lipoprotein; LDL, low-density lipoprotein.
1. Individualize energy needs and nutrition care based on metabolic profile, treatment goals, and changes person is willing and able to make

2. Carbs! (AMDR 45-65%)
   - Low-carbohydrate diets are not recommended
   - Sugars do not increase glycemia more than isocaloric amounts of starch
   - Factors influencing glycemic response to foods: glycemic index (GI) and glycemic load (GL)
   - Carbohydrate counting; portions of food containing 15 g carbohydrate
   - Exchange lists
Fiber

- 25 to 38 g of fiber per day with special emphasis on soluble fiber
- Recommend same as general public
- Research on higher fiber intake for people with diabetes has been inconclusive
Sweeteners

- Sucrose should be substituted in a meal plan for other carbohydrate
- Reduces intake of healthy foods or increases calorie intake
- Fructose has no benefit over sucrose
- Reduced calorie sweeteners: sugar alcohols
- Nonnutritive sweeteners: saccharin, aspartame, neotame, acesulfame potassium, and sucralose
Protein (AMDR 10-35%)

- Does not affect blood glucose levels in well-controlled diabetes
- Does not slow absorption of carbohydrate
- Recommend usual protein intake (15%–20% of kilocalories)
Dietary Fat (AMDR 20-35%)

- People with diabetes have similar risk to those with a history of CVD

- Recommendations
  - Total fat 25% to 35% of total kilocalories
  - Saturated fatty acids <7%
  - Minimized or eliminate *trans* fat
  - Very long omega-3 polyunsaturated fatty acids
  - Plant sterol and stanol esters; 2 to 3 g/day
Alcohol

- Abstain if history of abuse, pregnancy, medical problems; moderation for others
- Moderate amounts of alcohol with food have minimal effect on glucose and insulin
- Excessive alcohol (3+ drinks/day) contributes to hyperglycemia
Micronutrients

- No clear evidence of benefits of supplements
- High-risk groups
- Supplemental antioxidant vitamins have not been proven beneficial, and some evidence indicates that vitamins E and C and carotene are harmful
- No benefit has been shown for supplementation of chromium
Physical Activity and Exercise

- Integral part of treatment plan for diabetes
- Improve insulin sensitivity
- Reduce cardiovascular risk factors
- Weight control
- Improve well-being
- May prevent type 2 diabetes in high-risk individuals
- Glycemic responses to exercise in type 1 and type 2 diabetes

Prescription

- At least 150 min/wk of moderate-intensity aerobic physical activity or at least 90 min/wk of vigorous aerobic exercise
- Distribute over at least 3 days/wk with no more than 2 consecutive days without activity
- Resistance exercise 3×/wk
Medications

Oral Glucose-Lowering Medications

Biguanides

- Decreases amount of glucose released from liver.
- **Side effects**: Bloating, gas, diarrhea, upset stomach, loss of appetite (usually within the first few weeks of starting). Take with food to minimize symptoms. Metformin is not likely to cause low blood glucose. In rare cases, lactic acidosis may occur in people with abnormal kidney or liver function.

- **Drugs**: Metformin (Glucophage)
Oral Glucose-Lowering Medications

Insulin Secretagogues: Sulfonylureas

- Stimulates the pancreas to release more insulin
- **Side effects:** Low blood glucose, occasional skin rash, irritability, upset stomach

**Drugs:**
- Glimepiride (Amaryl)
- Glyburide (Diabeta, Micronase)
- Glipizide (Glucotrol, Glucotrol XL)
- Micronized glyburide (Glynase)
Medications

Oral Glucose-Lowering Medications
Thiazolidinediones (TZDs)

- Increases insulin sensitivity.
- **Side effects**: May cause side effects such as swelling (edema) or fluid retention.
- Does not cause low blood sugar when used alone.
- Increased risk of congestive heart failure in those at risk.

**Drugs**: Pioglitazone (Actos)
Medications

Oral Glucose-Lowering Medications

DPP-4 Inhibitors

- Increases insulin sensitivity (peripheral)
- **Side effects**: Stomach discomfort, diarrhea, sore throat, stuffy nose, upper respiratory infection.
- Do not cause low blood glucose.
- **Drugs**:
  - Sitagliptin (Januvia)
  - Saxagliptin (Onglyza)
  - Linagliptin (Tradjenta)
Medications

Oral Glucose-Lowering Medications
Alpha-glucosidase Inhibitors

Slows the absorption of carbohydrate into your bloodstream from GI s/p meal (competitive and reversible inhibition of enzymes responsible for breaking down carbohydrates to smaller sugar particles like glucose)

- Acarbose (Precose)
- Miglitol (Glyset)
Medications

Insulin

- Essential to survive in type 1 diabetes
- May be needed to restore glycemia in type 2 diabetes
- Onset, peak, and duration
- Inhaled insulin
- Individualize type and timing of insulin regimen based on eating and exercise habits and blood glucose levels
- Insulin pump
Each type of insulin has an onset, a peak, and a duration time.

- The **onset** is how soon the insulin starts to lower your blood glucose after you take it.
- The **peak** is the time the insulin is working the hardest to lower your blood glucose.
- The **duration** is how long the insulin lasts—the length of time it keeps lowering your blood glucose.
## Medications

<table>
<thead>
<tr>
<th>Type of Insulin</th>
<th>Onset of Action</th>
<th>Peak Action</th>
<th>Usual Effective Duration</th>
<th>Monitor Effect In</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rapid Acting</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulin lispro (Humalog)</td>
<td>&lt;15 min</td>
<td>1–2 hr</td>
<td>3–4 hr</td>
<td>2 hr</td>
</tr>
<tr>
<td>Insulin aspart (NovoLog)</td>
<td></td>
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<tr>
<td>Insulin glulisine (Apidra)</td>
<td></td>
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</tr>
<tr>
<td><strong>Short Acting</strong></td>
<td>0.5–1 hr</td>
<td>2–3 hr</td>
<td>3–6 hr</td>
<td>≈4 hr</td>
</tr>
<tr>
<td>Regular</td>
<td></td>
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<tr>
<td><strong>Intermediate-Acting</strong></td>
<td></td>
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</tr>
<tr>
<td>NPH</td>
<td>2–4 hr</td>
<td>4–10 hr</td>
<td>10–16 hr</td>
<td>8–12 hr</td>
</tr>
<tr>
<td><strong>Long Acting</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulin glargine (Lantus)</td>
<td>2–4 hr</td>
<td>Peakless</td>
<td>20–24 hr</td>
<td>10–12 hr</td>
</tr>
<tr>
<td>Insulin detemir (Levemir)</td>
<td>2–4 hr</td>
<td>Peakless</td>
<td>18–24 hr</td>
<td>10–12 hr</td>
</tr>
</tbody>
</table>

Monitoring

- Self-monitoring of blood glucose (SMBG) up to eight times per day
- Training and record keeping
- Used to adjust insulin doses and food
- Continuous ambulatory blood glucose monitoring
- Urine and blood ketones
Medical Nutrition Therapy for Type 1 Diabetes

- Integrate insulin regimen into usual eating habits and physical activity schedule
- Multiple injections (≥3/day) of insulin pump
- Half insulin as basal or background; other half before meals
- Total energy intake and CHO intake to avoid weight gain
Medical Nutrition Therapy for Type 2 Diabetes

- Lifestyle interventions to improve metabolic abnormalities (glycemia, dyslipidemia, hypertension)
- Progressive: usually need to add medication to MNT
- Blood glucose control, improve food choices, increase physical activity, moderate energy restriction to promote weight loss
- Teaching: carbohydrate sources, serving sizes, number of servings, meal planning, limiting fats
- SMBG
Medical Nutrition Therapy for Gestational Diabetes Mellitus

- About 7% of pregnancies
- High risk for type 2 diabetes later in life
- Screening and testing
- Carbohydrate-controlled meal plan, adequate energy, normoglycemia, and absence of ketosis
- Individualize and adjust meal plan throughout pregnancy
- Use of insulin
- Carbohydrate distribution
- Exercise
Hypoglycemia of Nondiabetic Origin

- Symptoms usually with BG < 65 mg/dL
- Postprandial (reactive) hypoglycemia
- Idiopathic reactive hypoglycemia: ↑ insulin sensitivity and ↓ glucagon response - rare
- Fasting (food-deprived) hypoglycemia
- Management: five or six small meals a day - spread CHO throughout the day - avoid simple CHO, avoid caffeine