Chapter 41
Assessment and Management of Patients With Diabetes Mellitus

Diabetes Mellitus
Definition

• A multisystem disease related to:
  – Chronic disorder
  – Abnormal metabolism of fuels glucose and fat
  – An endocrine disorder causes Abnormal insulin production
  – Impaired insulin utilization
  – Both abnormal production and impaired utilization

Diabetes Mellitus
Etiology and Pathophysiology

• Normal insulin metabolism
  – Produced by the β cells in the islets of Langherans of the pancreas
  – Facilitates normal glucose range of 70 to 120 mg/dl

• Leading cause of heart disease, stroke, adult blindness, and nontraumatic lower limb amputations

Leading cause of heart disease, stroke, adult blindness, and nontraumatic lower limb amputations
Diabetes Mellitus
Etiology and Pathophysiology

• Normal insulin metabolism
  – Promotes glucose transport from the bloodstream across the cell membrane to the cytoplasm of the cell

Diabetes Mellitus
Etiology and Pathophysiology

• Normal insulin metabolism
  – ↑ Insulin after a meal:
    • Stimulates storage of glucose as glycogen
    • Inhibits gluconeogenesis
  – • Enhances fat deposition in adipose tissue
  – • Increases protein synthesis
**Type 1 Diabetes Mellitus**

- Formerly known as “juvenile onset” or “insulin dependent” diabetes
- Most often occurs in people under 30 years of age
- Peak onset between ages 11 and 13

---

**Type 1 Diabetes Mellitus**

**Etiology and Pathophysiology**

- Progressive destruction of pancreatic β cells
- Autoantibodies cause a reduction of 80% to 90% of normal β cell function before manifestations occur

---

**Type 1 Diabetes Mellitus**

**Etiology and Pathophysiology**

- Causes:
  - Genetic predisposition
    - Related to human leukocyte antigens (HLAs)
    - Exposure to a virus

---

**Type 1 Diabetes Mellitus**

**Onset of Disease**

- Manifestations develop when the pancreas can no longer produce insulin
  - Rapid onset of symptoms
  - Present at ER with ketoacidosis
**Type 1 Diabetes Mellitus**

**Onset of Disease**

- Weight loss
- Polydipsia
- Polyuria
- Polyphagia

**Type 1 Diabetes Mellitus**

**Onset of Disease**

- Diabetic ketoacidosis (DKA)
  - Occurs in the absence of exogenous insulin
  - Life-threatening condition
  - Results in metabolic acidosis

**Type 2 Diabetes Mellitus**

**Etiology and Pathophysiology**

- Accounts for 90% of patients with diabetes
- Usually occurs in people over 40 years of age
- 80-90% of patients are overweight

- Pancreas continues to produce *some* endogenous insulin
- Insulin produced is either insufficient or poorly utilized by the tissues
Type 2 Diabetes Mellitus
Etiology and Pathophysiology

• Insulin resistance
  – Body tissues do not respond to insulin
  – Results in hyperglycemia

Type 2 Diabetes Mellitus
Etiology and Pathophysiology

• Impaired glucose tolerance (IGT)
  – Occurs when the alteration in β cell function is mild
  – Blood glucose levels are higher than normal but not high enough for a diagnosis of diabetes

Type 2 Diabetes Mellitus
Etiology and Pathophysiology

• Inappropriate glucose production by the liver
  – Not considered a primary factor in the development of type 2 diabetes

Type 2 Diabetes Mellitus
Etiology and Pathophysiology

• Insulin resistance syndrome (syndrome X)
  – Cluster of abnormalities that act synergistically to ↑ the risk of cardiovascular disease
Type 2 Diabetes Mellitus
Onset of Disease

- Gradual onset
- Person may go many years with undetected hyperglycemia
- Marked hyperglycemia (500 to 1000 mg/dl)

Gestational Diabetes

- Develops during pregnancy
- Detected at 24 to 28 weeks of gestation
- ↑ Risk for cesarean delivery, perinatal death, and neonatal complications

Secondary Diabetes

- Results from another medical condition or due to the treatment of a medical condition that causes abnormal blood glucose levels
  - Cushing syndrome
  - Hyperthyroidism
  - Parenteral nutrition

Clinical Manifestations
Type 1 Diabetes Mellitus

- Polyuria
- Polydipsia (excessive thirst)
- Polyphagia
- Weight loss
- Weakness and fatigue
- Ketoacidosis
Clinical Manifestations
Type 2 Diabetes Mellitus

- Non-specific symptoms
- Fatigue
- Recurrent infections
- Prolonged wound healing
- Visual changes

Diabetes Mellitus
Diagnostic Studies

- Fasting plasma glucose level >126 mg/dl
- Random plasma glucose measurement >200 mg/dl plus symptoms
- Two-hour OGTT level >200 mg/dl using a glucose load of 75 g

Diabetes Mellitus
Diagnostic Studies

- Impaired glucose tolerance (IGT)
  - Fasting blood glucose level >110 mg/dl but less than 126 mg/dl
- Hemoglobin A1C test:
  - Measures blood levels over 2-3 months (per text)
  - High levels of glucose will attach to hemoglobin
  - Helps to ensure that the patient’s gluco-meter is accurate.

Diabetes Mellitus
Collaborative Care

- Goals of diabetes management:
  - Reduce symptoms
  - Promote well-being
  - Prevent acute complications
  - Delay onset and progression of long-term complications
Diabetes Mellitus
Collaborative Care

- Patient teaching
- Nutritional therapy
- Drug therapy
- Exercise
- Self-monitoring of blood glucose

Diabetes Mellitus
Drug Therapy: Insulin

- Exogenous insulin:
  - Required for type 1 diabetes
  - Prescribed for the patient with type 2 diabetes who cannot control blood glucose by other means

Diabetes Mellitus
Drug Therapy: Insulin

- Types of insulin
  - Human insulin
    - Most widely used type of insulin
    - Cost-effective
    - ↓ Likelihood of allergic reaction
Diabetes Mellitus
Drug Therapy: Insulin

• Types of insulin
  – Insulins differ in regard to onset, peak action, and duration
  – Different types of insulin may be used for combination therapy

Diabetes Mellitus
Drug Therapy: Insulin

• Types of insulin
  – Rapid-acting: Lispro (onset 15', peak 60-90' and last from 2-4 hours)
  – Short-acting: Regular (Onset is 30-60', peak is 2-3h and last for 4-6 hours, and Regular insulin is only used for IV use.

---

### TABLE 36-2: Action of Insulin Preparations

<table>
<thead>
<tr>
<th>Type of Insulin</th>
<th>Onset (HR)</th>
<th>Peak (HR)</th>
<th>Duration (HR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapid Acting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lispro (Humalog)</td>
<td>0.25</td>
<td>0.5-2.5</td>
<td>3-6.5</td>
</tr>
<tr>
<td>Aspart (NovoLog)</td>
<td>0.25</td>
<td>1-3</td>
<td>3-5</td>
</tr>
<tr>
<td>Glulisine Apidra</td>
<td>0.25</td>
<td>0.5-1.5</td>
<td>3-5</td>
</tr>
<tr>
<td>Short Acting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regular (Novolin R, Humulin R)</td>
<td>0.5-1</td>
<td>2-3</td>
<td>4-6</td>
</tr>
<tr>
<td>Intermediate Acting</td>
<td>1-2</td>
<td>6-14</td>
<td>16-24</td>
</tr>
<tr>
<td>NPH (Novolin N, Humulin N)</td>
<td>0.5</td>
<td>4-8</td>
<td>24</td>
</tr>
<tr>
<td>Regular NPH 70/ regular 10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long Acting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glargine (Lantus)</td>
<td>2</td>
<td>Peak not defined</td>
<td>24</td>
</tr>
<tr>
<td>Detemir (Levemir)</td>
<td>2</td>
<td>Peak not defined</td>
<td>24</td>
</tr>
</tbody>
</table>

---
Diabetes Mellitus
Drug Therapy: Insulin

- Administration of insulin
  - Cannot be taken orally
  - SQ injection for self-administration
  - IV administration

Insulin Strengths

- Insulin Strengths
  - 100 U per mL or 500 U per mL
  - Administered in a sterile, single-use, disposable syringe
  - All insulin given parenterally
  - Regular insulin: either subcutaneous or intravenous

Injection Sites

- Process: pinch skin, inject needle at 90-degree angle
- Do not inject into muscle; do not massage after injecting
- Rotate injection sites
- Minimize painful injections

Injection Sites
Diabetes Mellitus
Drug Therapy: Insulin

- Problems with insulin therapy
  - Hypoglycemia
  - Allergic reactions
  - Lipodystrophy

- Somogy effect: The tendency of the body to react to extremely low blood sugar levels by overcompensating, resulting in high blood sugar, nocturnal hypoglycemia followed by rebound hypoglycemia due to excess insulin.

Problems with Insulin Injections

- Lipodystrophy: is a medical condition characterized by abnormal or degenerative conditions of the body's adipose tissue
- Lipoatrophy: is the term describing the localized loss of fat tissue.

TABLE 36-3 Giving Medications Safely: Insulin and Client Teaching

<table>
<thead>
<tr>
<th>NURSING IMLICATIONS</th>
<th>CLIENT/FAMILY TEACHING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discard vials of insulin whose expiration date has passed.</td>
<td>Know the manifestations of diabetes mellitus.</td>
</tr>
<tr>
<td>Discard any vial that is discolored or contains clumps, granules, or solid deposits on the sides.</td>
<td>Store opened insulin vials in a cool place for up to 4 weeks; avoid exposure to extreme temperatures (36°F to 48°F) or sunlight.</td>
</tr>
<tr>
<td>Check client's blood glucose level 10 minutes before giving an insulin injection.</td>
<td>Refrigerate unopened extra insulin vials; do not freeze them.</td>
</tr>
<tr>
<td>When drawing up insulin dose, always check type and dose with another nurse.</td>
<td>Refrigerated insulin should be brought to room temperature before using.</td>
</tr>
<tr>
<td>If a client's meal is delayed, hold administration of rapidly acting insulin.</td>
<td>Demonstrate self-administration of insulin (review procedure checklist in Box 36-3).</td>
</tr>
<tr>
<td>Monitor and maintain a record of blood glucose readings before each meal and at bedtime or as ordered.</td>
<td>Know how to mix two types of insulins.</td>
</tr>
<tr>
<td>Monitor fluid intake; notify physician when client eats an inadequate diet.</td>
<td>Discard outdated or discarded insulin.</td>
</tr>
<tr>
<td>Inspect injection sites for signs of lipodystrophy.</td>
<td>Keep a regular insulin vial available for emergencies.</td>
</tr>
<tr>
<td>Observe injection site for hardness, dimpling, or surgical areas; develop a plan for rotating injection sites.</td>
<td>Check blood glucose before meals, at bedtime, and as prescribed.</td>
</tr>
<tr>
<td>Monitor for signs and symptoms of hypoglycemia or hyperglycemia and take appropriate action.</td>
<td>If breakfast is delayed, also delay giving rapid-acting insulin.</td>
</tr>
</tbody>
</table>

Source: American Diabetes Association (2016). Insulin administration. Diabetes Care, 37(Suppl. 1), S51-S57.
Diabetes Mellitus
Drug Therapy: Oral Agents

- Not insulin
- Work to improve the mechanisms in which insulin and glucose are produced and used by the body

Diabetes Mellitus
Drug Therapy: Oral Agents

- Sulfonylureas: Glipizide, Glyburide and Glimepiride
- Meglitinides: Prandin & Starlix
- Biguanides: Metformin
- $\alpha$-Glucosidase inhibitors: Acarbose. Delay absorption of CHO
- Thiazolidinediones: Pioglitazone (Actos)

Diabetes Mellitus
Drug Therapy: Oral Agents

- Other drugs affecting blood glucose levels:
  - $\beta$-Adrenergic blockers
  - Thiazide
  - Loop diuretics

Diabetes Mellitus
Nutritional Therapy

- American Diabetes Association (ADA)
  - Guidelines indicate that within the context of an overall healthy eating plan, a person with diabetes can eat the same foods as a person who does not have diabetes
Diabetes Mellitus
Nutritional Therapy

• American Diabetes Association (ADA)
  – Overall goal:
    • Assist people in making changes in nutrition and exercise habits that will lead to improved metabolic control

Diabetes Mellitus
Nutritional Therapy

• Type 1 DM
  – Meal plan based on the individual’s usual food intake and is balanced with insulin and exercise patterns

Diabetes Mellitus
Nutritional Therapy

• Type 2 DM
  – Emphasis placed on achieving glucose, lipid, and blood pressure goals
  – Calorie reduction

Diabetes Mellitus
Nutritional Therapy

• Food composition
  – Individual meal plan developed with a dietitian
  – Nutritionally balanced
  – Does not prohibit the consumption of any one type of food
**Diabetes Mellitus**

**Nutritional Therapy**

- **Food composition**
  - **Alcohol**
    - High in calories
    - Promotes hypertriglyceridemia
    - Can cause severe hypoglycemia

---

**Diabetes Mellitus**

**Nutritional Therapy**

- **Diet teaching**
  - Dietitian initially provides instruction
  - Should include the patient’s family and significant others

---

**TABLE 36-6**  

<table>
<thead>
<tr>
<th>NUTRIENT</th>
<th>RECOMMENDED DAILY INTAKE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories (kcal)</td>
<td>Amount needed to attain and maintain as close as possible the desired body weight.</td>
</tr>
<tr>
<td>Carbohydrates</td>
<td>Individualized, based on client’s individual eating habits and glucose and lipid goals.</td>
</tr>
<tr>
<td>Sweeteners</td>
<td>Saccharin (Sweet’n Low), aspartame or neotame (Nutrasweet, Equal), sucralose (Splenda), or aspartame potasium (Savante) are safe when consumed within acceptable daily levels by FDA.</td>
</tr>
<tr>
<td>Protein</td>
<td>Approximately 13% to 20% of the daily caloric intake, should be from both animal and vegetable sources. Clients with nephropathy need lower protein intake.</td>
</tr>
<tr>
<td>Saturated fat and cholesterol</td>
<td>Less than 7% of the daily calories should be from saturated fats, with dietary cholesterol limited to 300 mg or less per day.</td>
</tr>
<tr>
<td>Fiber</td>
<td>20–35 g of dietary fiber each day from legumes, fruits, vegetables, whole grain products, and fiber-rich cereals (5 g or more fiber/serving).</td>
</tr>
<tr>
<td>Sodium</td>
<td>The same as for the general population: no more than 2,000 mg/day.</td>
</tr>
<tr>
<td>Vitamins and minerals</td>
<td>Sufficient to meet daily requirements.</td>
</tr>
<tr>
<td>Alcohol</td>
<td>Limit alcohol intake to one drink or less per day for women and two drinks or less per day for men. Ingest with a meal to decrease the risk of hypoglycemia.</td>
</tr>
</tbody>
</table>

Diabetes Mellitus
Nutritional Therapy

• Exercise
  – Several small carbohydrate snacks can be taken every 30 minutes during exercise to prevent hypoglycemia

Diabetes Mellitus
Nutritional Therapy

• Exercise
  – Best done after meals
  – Exercise plans should be individualized
  – Monitor blood glucose levels before, during, and after exercise

Diabetes Mellitus
Monitoring Blood Glucose

• Self-monitoring of blood glucose (SMBG)
  – Enables patient to make self-management decisions regarding diet, exercise, and medication

Diabetes Mellitus
Monitoring Blood Glucose

• Self-monitoring of blood glucose (SMBG)
  – Important for detecting episodic hyperglycemia and hypoglycemia
  – Patient training is crucial
Diabetes Mellitus
Pancreas Transplantation

Used for patients with type 1 diabetes who have end-stage renal disease and who have had or plan to have a kidney transplant

Diabetes Mellitus
Pancreas Transplantation

• Eliminates the need for exogenous insulin
• Can also eliminate hypoglycemia and hyperglycemia

Diabetes Mellitus
New Developments in Diabetic Therapy

• New insulin delivery systems not yet approved by the FDA:
  – Inhaled insulin
  – Skin patch
  – Oral spray
  – Insulin pills

Diabetes Mellitus
Nursing Management
Nursing Assessment

• Viral infections
• Medications
• Recent surgery
• Positive health history
• Obesity
Diabetes Mellitus
Nursing Management
Nursing Assessment

- Weight loss
- Thirst
- Hunger
- Poor healing
- Kussmaul respirations: Deep, rapid respiration characteristic of diabetic acidosis or other conditions causing acidosis.

Diabetes Mellitus
Subjective Data
- Presence of hyperglycemia manifestations: polyuria, polydipsia, polyphagia.
- Complaints of weight loss or gain; changes in appetite or vision; numbness and/or tingling or burning in feet; pain or burning with urination; or vulvar itching in females.
- Reports of slow-healing wounds.
- Family history of diabetes mellitus.
- Use of insulin or oral antidiabetic medications.

Objective Data
- Vital signs (blood pressure—standing and lying, pulse, respirations, temperature).
- Assess visual acuity; sensations of touch, position, pain, and temperature.
- Observe for signs of confusion; slurred speech, gait patterns, use of assistive devices for walking and abnormal wear patterns on shoes.
- Inspect oral cavity for bleeding and skin for dryness or excessive perspiration; presence of hair on lower extremities; lesions, redness over pressure points, cellulitis, or gangrene.
- Palpate peripheral pulses; color and temperature of lower extremities, and edema.
- Monitor and report blood glucose levels above or below expected range.

Diabetes Mellitus
Nursing Management
Nursing Diagnoses

- Ineffective therapeutic regimen management
- Fatigue
- Risk for infection
- Powerlessness

Diabetes Mellitus
Nursing Management
Planning

- Overall goals:
  - Active patient participation
  - No episodes of acute hyperglycemic emergencies or hypoglycemia
Diabetes Mellitus
Nursing Management

Planning

• Overall goals:
  – Maintain normal blood glucose levels
  – Prevent chronic complications
  – Lifestyle adjustment with minimal stress

Nursing Implementation

• Health Promotion
  – Identify those at risk
  – Routine screening for overweight adults over age 45

• Acute Intervention
  – Hypoglycemia
  – Diabetic ketoacidosis
  – Hyperosmolar hyperglycemic nonketotic syndrome

• Acute Intervention
  – Stress of illness and surgery:
    • ↑ Blood glucose level → Hyperglycemia
    • Continue regular meal plan
Diabetes Mellitus
Nursing Management
Nursing Implementation

• Acute Intervention
  – Stress of illness and surgery:
    • Increase intake of noncaloric fluids
    • Continue taking oral agents and insulin
    • Frequent monitoring of blood glucose

Diabetes Mellitus
Nursing Management
Nursing Implementation

• Ambulatory and Home Care
  – Overall goal:
    • Enable the patient or caregiver to reach an optimal level of independence

Diabetes Mellitus
Nursing Management
Nursing Implementation

• Ambulatory and Home Care
  – Insulin therapy and oral agents
  – Personal hygiene
  – Medical identification and travel
  – Patient and family teaching

Diabetes Mellitus
Nursing Management
Evaluation

• Knowledge
• Endurance
• Immune status
• Health beliefs
Diabetes Mellitus
Acute Complications

- Diabetic ketoacidosis (DKK)
- Hyperosmolar hyperglycemic nonketotic syndrome (HHNS)
- Hypoglycemia

Diabetes Ketoacidosis (DKA)

- Life-threatening illness in type 1
- Hyperglycemia, dehydration, coma
- Excess glucose leads to dehydration, sodium and potassium loss
- Burning of fat leads to ketosis
- Kidneys unable to excrete ketones, leads to ketoacidosis

DKA

- Treatment
  - Hospital admission
  - Treatment: fluids, insulin, electrolytes

Hyperosmolar hyperglycemic nonketotic syndrome (HHNS)

- Hyperosmolar Hyperglycemic Nonketotic Syndrome, or HHNS, is a serious condition most frequently seen in older persons. HHNS can happen to people with either type 1 or type 2 diabetes, but it occurs more often in people with type 2. HHNS is usually brought on by something else, such as an illness or infection.
- In HHNS, blood sugar levels rise, and your body tries to get rid of the excess sugar by passing it into your urine. You make lots of urine at first, and you have to go to the bathroom more often. Later you may not have to go to the bathroom as often, and your urine becomes very dark. Also, you may be very thirsty. Even if you are not thirsty, you need to drink liquids. If you don't drink enough liquids at this point, you can get dehydrated.
- If HHNS continues, the severe dehydration will lead to seizures, coma and eventually death. HHNS may take days or even weeks to develop. Know the warning signs of HHNS.
**Hypoglycemia**

- Type 1 or type 2 diabetes
- Causes
  - Too much insulin
  - Overdose of oral antidiabetic agents
  - Too little food
  - Excess physical activity
- Sudden onset; blood glucose < 50 mg/dL

**Hypoglycemia Unawareness**

- May develop in some people with long-standing type 1 diabetes
- No symptoms of hypoglycemia in the presence of a low blood glucose level
Hypoglycemia

- Treatment
  - Mild
    - Immediate treatment
    - 15 g rapid-acting sugar
  - Severe
    - Hospitalized
    - Intravenous glucose

Diabetes Mellitus

Chronic Complications

- Macrovascular (atherosclerotic plaque)
  - Coronary arteries → (MIs)
  - Cerebral arteries → (strokes)
  - Peripheral vessels → (ulcers, amputations, infection)
- Microvascular (capillary damage)
  - Retinopathy
  - Neuropathy
  - Nephropathy

Macrovascular Complications

- Macrocirculation
  - Large blood vessels undergo changes due to atherosclerosis
- Complications
  - Coronary artery disease
  - Stroke
  - Peripheral vascular disease

Complication: CAD

- Risk factor for an MI
- High cholesterol and high triglycerides
Complication: Stroke
• Two to six times more likely to occur in type 2
• Hypertension plays a role

Complication: Peripheral Vascular Disease
• Greater in type 2
• Diabetes-induced arteriosclerosis
• Can lead to leg ulcers and gangrene

Complication: Diabetic Retinopathy
• Changes in the retinal capillaries; lead to retinal ischemia, retinal hemorrhage, or detachment
• Retinopathy stages: nonproliferative and proliferative
• Leading cause of blindness in people ages 20 to 74
• Yearly eye exams are recommended

Microvascular Complications
• Microcirculation
  – Eyes
  – Kidneys
  – Nerves
Complication: Diabetic Nephropathy

- Disease of the kidneys
- Characterized by albumin in the urine, hypertension, edema, renal insufficiency
- Most common cause of renal failure
- First indication: microalbuminuria
- Treatment: ACE inhibitors

Complication: Diabetic Neuropathy

- Disorder of the peripheral nerves and autonomic nervous system
- Results: sensory and motor impairments, postural hypotension, delayed gastric emptying, diarrhea, impaired genitourinary function
- Result from the thickening of the capillary membrane and destruction of myelin sheath

Complication: Diabetic Neuropathy

- Bilateral sensory disorders
  - Appear first in toes, feet, and progress upward to fingers and hands
- Treatment
  - None specific
  - Focus on controlling neuropathic pain with tricyclic antidepressants or topical cream capsaicin (Zostrix)
Complication: Autonomic Neuropathy

• Involves numerous body systems such as cardiovascular, gastrointestinal, genitourinary

Figure 41-10 Neuropathic ulcers occur on pressure points in areas with diminished sensation as diabetic neuropathy. Pain is absent (and therefore the ulcer may go unnoticed).

Copyright © 2004 Lippincott Williams & Wilkins.