Chapter 44

Drugs for Diabetes Mellitus

Pancreas

- Both endocrine and exocrine gland
  - Insulin released when blood glucose increases
  - Glucagon released when blood glucose decreases
- Hormones and drugs can affect blood sugar (hyperglycemic or hypoglycemic effects)

Type I Diabetes Mellitus

- Caused by absolute lack of insulin secretion
  - Due to autoimmune destruction of pancreatic islet cells
- If untreated, results in serious, chronic conditions
  - Cardiovascular damage
  - Nervous system damage
Type II Diabetes Mellitus

- **Causes**
  - Lack of sensitivity of insulin receptors at target cells (insulin resistance)
  - Deficiency in insulin secretion
- If untreated, results in same chronic conditions as type 1 DM

Type I Diabetes Mellitus

- **Treatment**
  - Dietary restrictions
  - Exercise
  - Insulin therapy

Insulin Preparations Vary

- Onset of action
- Time to peak effect
- Duration

Insulin

- Almost all insulin used today is human insulin
  - Made by recombinant DNA technology
  - More effective, fewer allergies, less resistance
  - Modified to be more rapid (Humalog) or have prolonged action (Lantus)

Insulin Administration

- Routes of administration
  - Subcutaneous (SQ)
  - Inhaled—Exubera, approved in 2006
  - Intravenous
    - Only regular insulin can be given intravenously

Figure 44.3 Insulin delivery methods: (a) insulin inhalation device; (b) insulin pump. Source: Pfizer Inc.
Hypoglycemia

- Can result from
  - Insulin overdose
  - Improper timing of insulin dose
  - Skipping a meal

Signs and Symptoms of Hypoglycemia

- Tachycardia, confusion
- Sweating, drowsiness
- Convulsions, coma, death

Hyperglycemia

- Can result from underdose of insulin or oral hypoglycemic

Signs and Symptoms of Hyperglycemia

- Fasting blood glucose greater than 126 mg/dl
- Polyuria, polydipsia, polyphagia
- Glucosuria, weight loss/gain, fatigue

Role of the Nurse

- Monitor client’s condition
- Provide client education
- Obtain medical, surgical, drug history
- Assess lifestyle and dietary habits
- Obtain description of symptomology and current therapies
Insulin Therapy

• Be familiar with onset, peak, and duration of action of prescribed insulin
• Be aware of important aspects of each specific insulin

Insulin Therapy (continued)

• Not all types of insulin are compatible
  – May not be mixed together in single syringe
  – Clear insulin must be drawn into syringe first
• Know signs and symptoms of hypoglycemia and hyperglycemia

Oral Hypoglycemic Therapy

• Assessment
  – Physical examination, health history
  – Psychosocial history, lifestyle history
• Teach client: keep blood glucose levels within normal range
• Blood glucose should be monitored daily
• Urinary ketones should be monitored if blood glucose is over 300 mg/dl

Oral Hypoglycemic Therapy (continued)

• Monitor intake and output
• Review lab studies for liver-function abnormalities
• Monitor client for signs and symptoms of illness or infection
• Administer oral hypoglycemics as directed by prescriber

Type 2 Diabetes Mellitus

• Treatment
  – Controlled through lifestyle changes
  – Treated with oral hypoglycemic drugs
    • All oral hypoglycemics lower blood-glucose levels
    • Have potential to cause hypoglycemia
    • Not effective for type 1 DM
• People with type II diabetes mellitus should have a preprandial blood sugar below 110 mg/dl

Classes of Oral Hypoglycemic Drugs

• Sulfonylureas
• Biguanides
• Thiazolidinediones
• Alpha-glucosidase inhibitors
• Meglitinides
Sulfonylureas

- Stimulate release of insulin from pancreatic islet cells
- Increase sensitivity of insulin receptors on target cells
- Most common adverse effect is hypoglycemia
  - Usually caused by taking too much medication or not eating enough food

Biguanides

- Metformin (Glucophage), only drug in this class
- Decreases hepatic production of glucose (gluconeogenesis) and reduces insulin resistance
- Does not promote insulin release from pancreas

Biguanides (continued)

- Most side effects are minor and GI-related
- New extended-release formulation of metformin (Glumetza) allows for once-daily dosing

Alpha-Glucosidase Inhibitors

- Block enzymes in small intestine responsible for breaking down complex carbohydrates into monosaccharides
- Digestion of glucose delayed
  - Carbohydrates must be in monosaccharide form to be absorbed
- Agents usually well tolerated; have minimal side effects
- Most common side effects are GI-related

Thiazolidinediones (Glitazones)

- Reduce blood glucose by decreasing insulin resistance and inhibiting hepatic gluconeogenesis
- Optimal lowering of blood glucose may take 3 to 4 months of therapy
- Most common adverse effects: fluid retention, headache, weight gain
- Hypoglycemia does not occur with drugs in this class

Meglitinides

- Newer class of oral hypoglycemics
- Act by stimulating release of insulin from pancreatic islet cells
- Both agents in this class have short durations of action of 2–4 hours
- Efficacy equal to that of sulfonylureas
- Well tolerated
- Hypoglycemia most common adverse effect
Other Agents

- Two new drugs entered market in 2005
  - Exenatide (Byetta): injectable drug that belongs to class of drugs called incretin mimetics
    - Mimic effects of incretins—hormones released into blood by intestine in response to food
  - Pramlintide (Symlin): injectable drug for type 1 and type 2; resembles human amylin
    - Hormone produced by pancreas after meals; helps body regulate blood glucose

Insulins

- **Prototype drug:** regular insulin
- **Mechanism of action:** to promote entry of glucose into cells
- **Primary use:** short-acting insulin, with an onset of 30 to 60 minutes, a peak effect at 2 to 3 hours, and a duration of 5 to 7 hours to quickly decrease blood glucose
  - Also for emergency management of ketoacidosis
- **Adverse effects:** hypoglycemia

Oral Hypoglycemics

- **Prototype drug:** glipizide (Glucotrol, Glucotrol XL)
- **Mechanism of action:** to stimulate pancreas to secrete more insulin
  - Also increases sensitivity of insulin receptors at target tissues
- **Primary use:** for treatment of type 2 diabetes
- **Adverse effects:** hypoglycemia, rashes, photosensitivity possible
  - Some clients experience nausea, vomiting, loss of appetite

Clients Receiving Insulin Therapy (continued)

- Assess blood-glucose level
- Assess appetite and ability to eat
- Assess subcutaneous areas for potential insulin injection sites
- Assess knowledge of insulin and ability to self-administer insulin
Clients Receiving Insulin Therapy

• Nursing Diagnoses
  – Risk for injury (hypoglycemia), related to adverse effects of drug therapy
  – Deficient knowledge, related to need for self-injection
  – Risk for imbalanced nutrition, related to adverse effects of drug therapy
  – Risk for infection, related to blood-glucose elevations and impaired circulation

• Planning—client will
  – Immediately report irritability, dizziness, diaphoresis
    • Also hunger, behavior changes, changes in LOC
  – Demonstrate ability to self-administer insulin
  – Demonstrate understanding of lifestyle modifications necessary for success

• Implementation
  – Increase frequency of blood-glucose monitoring if client is experiencing fever, nausea, vomiting, or diarrhea
  – Check urine for ketones if blood glucose is over 300 mg/dl
  – Monitor weight on routine basis
  – Monitor vital signs
  – Monitor potassium level
  – Check blood glucose
  – Feed client simple sugar at first sign of hypoglycemia

• Evaluation—client
  – States need to immediately report irritability, dizziness, diaphoresis
    • Also hunger, behavior changes, changes in LOC
  – Demonstrates ability to self-administer insulin
  – Verbalizes understanding of lifestyle modifications necessary for success

Clients Receiving Oral Hypoglycemic Therapy

• Assessment
  – Obtain complete health history
  – Assess for pain location and level
  – Assess client’s knowledge of drug
  – Assess client’s ability to conduct blood-glucose testing
Clients Receiving Oral Hypoglycemic Therapy

• Nursing diagnoses
  – Risk for injury (hypoglycemia), related to adverse effects of drug therapy
  – Pain (abdominal), related to adverse effects of drug
  – Deficient knowledge, related to drug therapy
  – Deficient knowledge, related to blood-glucose testing

• Planning—client will
  – Describe signs and symptoms that should be reported immediately
  – Demonstrate an ability to accurately self-monitor blood glucose
  – Maintain blood glucose within a normal range

• Implementation
  – Monitor blood glucose daily
  – Monitor urinary ketones if blood glucose is over 300 mg/dl
  – Monitor for signs of lactic acidosis if client is receiving biguanide
  – Review lab tests for abnormalities in liver function
  – Obtain accurate history of alcohol use
  – Monitor blood glucose frequently
    • At beginning of therapy, in elderly clients, in those taking beta-blocker
  – Monitor weight, weighing at same time of day each time
  – Monitor vital signs
  – Monitor skin for rashes and itching
  – Monitor activity level

• Evaluation—client
  – Accurately describes signs and symptoms that should be reported immediately
  – Demonstrates ability to accurately self-monitor blood glucose
  – Maintains blood glucose within normal range

Insulin Preparations

Table 44.1 Insulin Preparations
### Oral Hypoglycemics

#### Table 44.2 Oral Hypoglycemics

<table>
<thead>
<tr>
<th>Name of Drug</th>
<th>Route of Administration</th>
<th>Initial Dose</th>
<th>Maximum Dose</th>
<th>Common Indications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glimepiride</td>
<td>Oral</td>
<td>1 mg</td>
<td>4 mg</td>
<td>Type 2 Diabetes</td>
</tr>
<tr>
<td>Glibenclamide</td>
<td>Oral</td>
<td>1.5 mg</td>
<td>60 mg</td>
<td>Type 2 Diabetes</td>
</tr>
<tr>
<td>Gliclazide</td>
<td>Oral</td>
<td>5 mg</td>
<td>160 mg</td>
<td>Type 2 Diabetes</td>
</tr>
<tr>
<td>Glimperide</td>
<td>Oral</td>
<td>1 mg</td>
<td>2 mg</td>
<td>Type 2 Diabetes</td>
</tr>
</tbody>
</table>

#### Table 44.2b Oral Hypoglycemics

<table>
<thead>
<tr>
<th>Name of Drug</th>
<th>Route of Administration</th>
<th>Initial Dose</th>
<th>Maximum Dose</th>
<th>Common Indications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metformin</td>
<td>Oral</td>
<td>500 mg</td>
<td>2000 mg</td>
<td>Type 2 Diabetes</td>
</tr>
<tr>
<td>Acarbose</td>
<td>Oral</td>
<td>50 mg</td>
<td>300 mg</td>
<td>Type 2 Diabetes</td>
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<tr>
<td>Pioglitazone</td>
<td>Oral</td>
<td>30 mg</td>
<td>150 mg</td>
<td>Type 2 Diabetes</td>
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<td>TZD</td>
<td>Oral</td>
<td>1 mg</td>
<td>2 mg</td>
<td>Type 2 Diabetes</td>
</tr>
</tbody>
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