



# Endocrine System

## PHYSIOLOGY OF THE ENDOCRINE SYSTEM

- A. Pituitary gland - Often referred to as the “master gland” because it secretes hormones that control hormone secretion of other endocrine glands.
  - B. Thyroid gland - Primary function of thyroid hormone is to control the level of cellular metabolism by secreting thyroxin ( $T_4$ ) and triiodothyronine ( $T_3$ ).
  - C. Parathyroid gland - Four small parathyroid glands are located near or embedded in the thyroid gland, which secrete parathyroid hormone (PTH) that is primarily involved in the control of serum calcium levels.
  - D. Pancreas - Produces the enzymes trypsin, amylase, and lipase, which are necessary for the digestion and absorption of nutrients; contains the islets of Langerhans, which contain beta cells that are responsible for the production of insulin. Insulin is necessary for maintaining normal carbohydrate metabolism and glucose utilization.
  - E. Adrenal glands – Main body is the adrenal cortex that is responsible for the secretion of glucocorticoids, mineralocorticoids, and adrenal sex hormones (androgens and estrogen); adrenal cortical function is essential for life. The adrenal medulla secretes catecholamines, epinephrine, and norepinephrine; under the influence of the sympathetic nervous system.
    - 2. Assess for changes in mental or emotional status.
    - 3. Evaluate reflexes and neuromuscular response to stimuli.
    - 4. Evaluate serum calcium levels.
- D. Pancreas problems.
- 1. Evaluate changes in weight, particularly increase in weight in the adult and decrease in weight in the child.
  - 2. Evaluate alterations in fluid balance.
  - 3. Evaluate changes in mental status.
  - 4. Evaluate serum glucose levels.
  - 5. Evaluate pancreatic enzyme studies.
  - 6. Evaluate the abdomen for epigastric pain and abdominal discomfort.
- E. Adrenal glands.
- 1. Adrenal medulla.
    - a. Evaluate changes in blood pressure.
    - b. Assess for changes in metabolic rate.
  - 2. Adrenal cortex.
    - a. Evaluate changes in weight.
    - b. Evaluate changes in skin color and texture, and in the presence and distribution of body hair.
    - c. Assess cardiovascular system for instability as evidenced by labile blood pressure and cardiac output.
    - d. Evaluate GI discomfort.
    - e. Assess status of potassium and sodium levels.
    - f. Assess for changes in glucose metabolism.
    - g. Assess for changes in reproductive system and in sexual activity.
    - h. Evaluate changes in muscle mass.

### System Data Collection

- A. Pituitary problems.
  - 1. Assess for growth imbalance.
  - 2. Assess for secondary characteristics appropriate for age.
  - 3. Assess for hormonal imbalances throughout the endocrine system organs.
- B. Thyroid problems.
  - 1. Assess for changes in weight and appetite: increased or decreased.
  - 2. Assess for intellectual development and mental changes: increased irritability, excitability, nervousness, altered mood and affect, confusion, and coma.
  - 3. Assess for changes in hair and skin, altered general appearance, and sexual dysfunction.
- C. Parathyroid problems.
  - 1. History of problems of calcium metabolism and thyroid surgery.



### Hyperpituitary: Acromegaly

\* **Acromegaly is most often the result of a benign slow growing tumor (pituitary adenoma) that secretes growth hormones. It occurs after the closure of epiphyses of the long bones.**

#### Data Collection

- A. Enlargement of the hands and feet and hypertrophy of the skin.
- B. Changes in facial features: protruding jaw, slanting forehead, and an increase in the size of the nose.

### Treatment

Surgical intervention is primary method of correcting problem; hypophysectomy may be accomplished by the trans-sphenoidal approach.

### Nursing Intervention

- ❖ **Goal:** To provide supportive preoperative care (see Chapter 3).
- ❖ **Goal:** To ensure that the client will not experience complications after hypophysectomy.
  - A. Elevate the head 30 degrees.
  - B. Discourage coughing, sneezing, or straining at stool to prevent cerebrospinal fluid leak.
  - C. Assess for symptoms of increasing intracranial pressure (see Chapter 15).
  - D. Evaluate urine for excessive increase in volume (greater than 200 mL/hr) or specific gravity less than 1.005 (i.e., development of diabetes insipidus).
  - E. Frequent oral hygiene with nonirritating solutions.
- ❖ **Goal:** To assist client to reestablish hormone balance after hypophysectomy (adrenal insufficiency and hypothyroidism are most common complications).
  - A. Administer corticosteroids and ADH-regulating medications (see Appendix 5-7).



### Diabetes Insipidus

\* **Diabetes insipidus (DI)** is a problem of the posterior pituitary characterized by a deficiency of ADH (or kidney's inability to respond to ADH). When it occurs, it is most often associated with neurological conditions, surgery, tumors, head injury, or inflammatory problems.

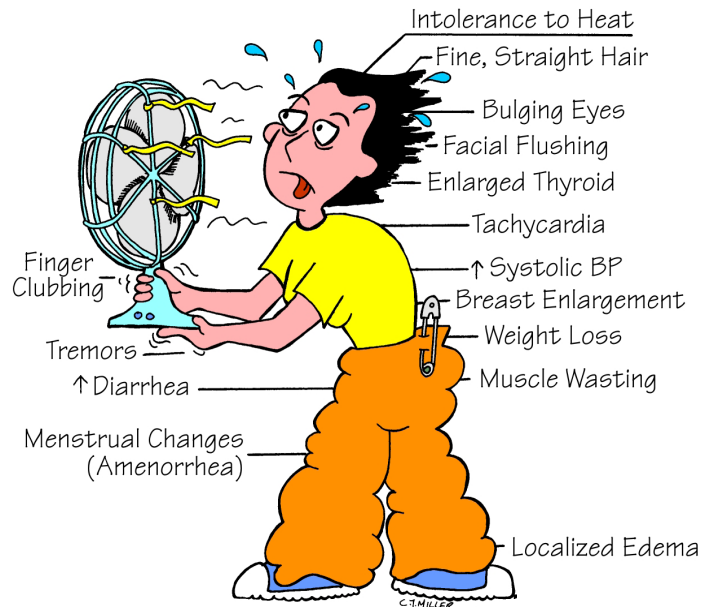
### Data Collection

- A. Excretion of excessive amounts urine (greater than 200 mL/hr) (Polyuria).
- B. Polydipsia, weakness.
- C. Low urine specific gravity (1.001 to 1.005).
- D. Severe dehydration (tachycardia, poor skin turgor, dry mucous membranes).
- E. Increase in serum sodium level (greater than 147 mEq/L).

### Nursing Intervention

- ❖ **Goal:** To maintain fluid and electrolyte balances (see Chapter 6).
  - A. Encourage intake of fluids containing electrolytes for clients with DI.
  - B. Monitor intake and output carefully. Weigh daily.
  - C. Evaluate urine specific gravity for changes.
  - D. Assess hydration status.

## HYPERTHYROIDISM



**FIGURE 8-1 Graves' Disease.** (From Zerwekh J, Claborn J, Miller CJ: *Memory notebook of nursing*, vol 1, ed 3, Ingram, 2007, Nursing Education Consultants, Inc.)



### Hyperthyroidism

\* **Hyperthyroidism** (also called Graves' disease) or **thyrotoxicosis** (the signs and symptoms caused by hypermetabolism) is characterized by excessive output of thyroid hormones. (Figure 8-1)

### Data Collection

- A. Intolerance to heat.
- B. Significant weight loss, despite increased appetite and food intake.
- C. Tachycardia, increase in systolic blood pressure.
- D. Increased peristalsis, leading to diarrhea.
- E. Hand tremors at rest.
- F. Visual problems.
  1. Exophthalmos (bulging eyeballs).
  2. Changes in vision, eyelid retraction (lid lag).
- G. Changes in menstrual cycle - amenorrhea.
- H. Enlarged, palpable thyroid gland.
- I. Mood fluctuations.
- J. Diagnostics (see Appendix 8-1) - increase in  $T_3$ ,  $T_4$ , and free  $T_4$  serum levels, decrease in TSH, radioactive iodine uptake test ( $I^{123}$ ) greater than 50%.

### Complications

- A. Thyroid storm or crisis: may occur after surgery or treatment with radioactive iodine.
  1. Systolic hypertension, tachycardia.
  2. Increased temperature (greater than 102° F).
  3. Increased agitation and anxiety.

- B. Calcium deficit may occur as a result of trauma to the parathyroid (see Hypoparathyroid).

### Treatment

- A. Surgical: thyroidectomy.  
 B. Medical.  
 1. Reduce thyroid tissue: irradiation of thyroid gland with radioactive iodine ( $I^{131}$ ), eventually resulting in hypothyroid state.  
 2. Medications to decrease thyroid synthesis and release (see Appendix 8-2).

### Nursing Intervention

- ❖ **Goal:** To decrease effects of excess thyroid hormone.
- A. Decrease environmental stress (lights, visitors, noise, etc.).
- B. Cool environment.
- C. Sedatives, if appropriate.
- D. Well-balanced meals (high in calories and high in vitamins); small meals served 4 to 6 times per day.
- ❖ **Goal:** To protect eyes of client experiencing complications caused by eye changes.
- A. Eye drops or ointment.
- B. Assess for excess tearing, a sign of dry cornea.
- C. Eye patches or mask may be necessary at night.
- ❖ **Goal:** To maintain homeostasis in client experiencing thyroid storm (or crisis).
- A. Decrease body temperature and heart rate.
  1. Hypothermia blanket.
  2. Acetaminophen to decrease fever.
  3. Propranolol (**Inderal**) and digitalis to treat cardiac issues.
- B. Oxygen to meet increased metabolic demands.
- C. IV fluids.
- D. Antithyroid medications and iodine preparations to decrease  $T_4$  output.
- ❖ **Goal:** To provide preoperative nursing measures if surgery is indicated.
- A. Demonstrate to client how to provide neck support after surgery.
- B. Administer iodine preparations to decrease vascularity of the thyroid gland.
- ❖ **Goal:** To maintain homeostasis after thyroidectomy.
- A. Maintain semi-Fowler's position to avoid tension on the suture line.
- B. Administer analgesics for pain.
- C. Administer IV fluids until nausea and swallowing difficulty subside.
- D. Check dressings on the side and back of the neck for bleeding and report any bleeding.
- E. Apply ice collar to decrease edema.
- F. Check calcium levels; parathyroid may have been damaged or accidentally removed.
- G. Evaluate temperature elevations; temperature increase may be early indication of thyroid storm.



**TEST ALERT:** Monitor status of client who has under-gone surgery (hemorrhage, airway, wound).

- ❖ **Goal:** To prevent complication of respiratory distress after thyroidectomy.
- A. Assess client frequently for noisy breathing and increased restlessness.
- B. Evaluate voice changes; increasing hoarseness may be indicative of laryngeal edema. Report any changes immediately.
- C. Keep tracheotomy set readily available.
- ❖ **Goal:** To decrease radiation exposure in client being treated as an in-patient with radioactive iodine ( $I^{131}$ ).
- A. All body secretions are contaminated because this is a systemic type of radiation.
- B. Advise family members to avoid oral contact because saliva is contaminated.
- C. For any body fluid spills (urine, vomitus, etc.), contact the radiation safety officer for the facility. Do not clean up the spill.
- D. General guideline is to maintain 1 meter (a little more than 3 feet) distance from the client unless direct contact is necessary.
- E. Infants and pregnant women should avoid contact with client for approximately 2 days.
- F. All health care personnel providing direct care to client should wear a radiation badge.
- G. Monitor client for a transient period of several days to weeks when the symptoms of hyperthyroidism may actually worsen after radioactive iodine therapy.



**TEST ALERT:** Observe client for side effects of chemotherapy or radiation.



### Home Care

- A. Thyroid levels checked annually.  
 B. Lifelong thyroid replacement.  
 C. If excessive fatigue or tachycardia and tremors become a consistent problem, notify health care provider.



### Hypothyroidism

\* **Hypothyroidism is characterized by a slow deterioration of thyroid function. It occurs primarily in older adults and five times more frequently in women (ages 30 – 60) than in men. Myxedema coma is a life-threatening form of hypothyroidism**

### Data Collection

- A. Early clinical manifestations.
1. Extreme fatigue, menstrual disturbances.
  2. Hair loss, brittle nails, and dry skin.
  3. Intolerance to cold, anorexia.
  4. Constipation, apathy.

- B. Late clinical manifestations.
  1. Subnormal temperature.
  2. Cardiac complications (bradycardia, congestive heart failure, hypotension).
  3. Weight gain and edema, thickened skin.
  4. Change or decrease in level of consciousness.
- C. Pediatric implications: cretinism.
  1. Identified after birth by mandatory state screening tests.
  2. Hypotonia, hyporeflexia, poor feeding.
  3. Hypotonic abdominal musculature – constipation, protruding abdomen (umbilical hernia).
- D. Diagnostics - decrease in serum  $T_3$  and  $T_4$  levels, increase in TSH level.

### Treatment

- A. Medical management.
  1. Replacement of thyroid hormone.
  2. Low-calorie diet to promote weight loss.
  3. Decrease in cholesterol intake.
  4. Pediatric - If replacement thyroid hormone is accomplished shortly after birth, it is possible that the child will have normal physical growth and intellectual development.

### Complications

- A. Thyroid hormone replacement will increase the work load of the heart and increase myocardial oxygen requirements.
- B. Observe client for development of cardiac failure.

### Nursing Intervention

- ❖ **Goal:** To assist the client to return to hormone balance.
- A. Begin thyroid replacement and evaluate client's response; advise client that it will be about 7 days before he or she begins to feel better.
- B. Provide a warm environment.

✓ **NURSING PRIORITY:** Administer sedatives and hypnotics with caution because of increased susceptibility. These medications tend to precipitate respiratory depression in the client with hypothyroidism.

- C. Prevent and/or treat constipation.
- D. Assess progress.
  1. Decrease in body weight.
  2. Intake and output balance.
  3. Decrease in visible edema.
  4. Energy level and mental alertness should increase in 7 to 14 days and continue to rise until normal.
- E. Evaluate cardiovascular response to medication.
- ❖ **Goal:** To assist client to understand implications of disease and requirements for health maintenance.
  - A. Need for lifelong drug therapy.
  - B. Diabetic client needs to evaluate blood sugar levels

more frequently; thyroid preparations may alter effects of hypoglycemic agents.

- C. Continue to reinforce teaching information as client begins to make progress; early in the disease, the client may not comprehend importance of information.



### Hyperparathyroidism

\* **Hyperparathyroidism is characterized by excessive secretion of parathyroid hormone (PTH), resulting in hypercalcemia. Excessive PTH leads to decalcification of the bones, as the calcium moves from the bones into the serum, hypercalcemia results and possible kidney damage.**

### Data Collection

- A. Bone cysts and pathological fractures.
- B. Renal calculi, azotemia.
  1. Hypertension caused by renal failure.
  2. Repeated urinary tract and renal infections.
- C. Central nervous system problems of lethargy, stupor, and psychosis.
- D. GI problems.
  1. Anorexia, nausea and vomiting.
  2. Constipation, development of peptic ulcer.
- E. Diagnostics - increased level of serum total calcium; decreased level of serum phosphorous; increased PTH.

### Treatment

- A. Decrease level of circulating calcium.
- B. Parathyroidectomy.

### Nursing Intervention

- ❖ **Goal:** To decrease the level of serum calcium.
  - A. High fluid intake to dilute serum calcium and urine calcium levels.
  - B. Encourage mobility, because immobility increases demineralization of bones.
  - C. Limit foods high in calcium.
- ❖ **Goal:** To assess client's tolerance of and response to increased PTH level.
  - A. Assess for skeletal involvement – presence of bone pain.
  - B. Assess for renal involvement.
    1. Strain urine for stones.
    2. Evaluate for low back pain (renal).
    3. Check for hematuria.
    4. Assess intake and output carefully.
  - C. Monitor for cardiac arrhythmias due to increased calcium.
- ❖ **Goal:** To provide appropriate preoperative measures if surgery is indicated (see Chapter 3).
- ❖ **Goal:** To prevent postoperative complications of parathyroidectomy.
  - A. Care of client who has undergone parathyroidectomy is same as that for client who has undergone thyroidectomy.





## Hypoparathyroidism

\* Hypoparathyroidism is characterized by a decrease in the PTH level, resulting in hypocalcemia and elevated serum phosphate levels. Severe hypocalcemia results in tetany.

### Data Collection

- A. May occur with inadvertent removal of parathyroid gland during thyroidectomy or radical neck dissection.
- B. Muscle weakness/spasms.
- C. Overt/acute tetany (potentially fatal).
  1. Bronchospasm, laryngospasm.
  2. Seizures, cardiac dysrhythmias.
- D. Diagnostics - decreased serum calcium and PTH levels, increased serum phosphate levels.

### Treatment

- A. Vitamin D to enhance calcium absorption.
- B. Increased calcium in the diet.



**TEST ALERT:** Adjust food and fluid intake to improve fluid and electrolyte balances.

- C. Acute.
  1. Replace calcium through slow IV drip (calcium gluconate, calcium chloride).
  2. Sedatives, anticonvulsants.

### Nursing Intervention

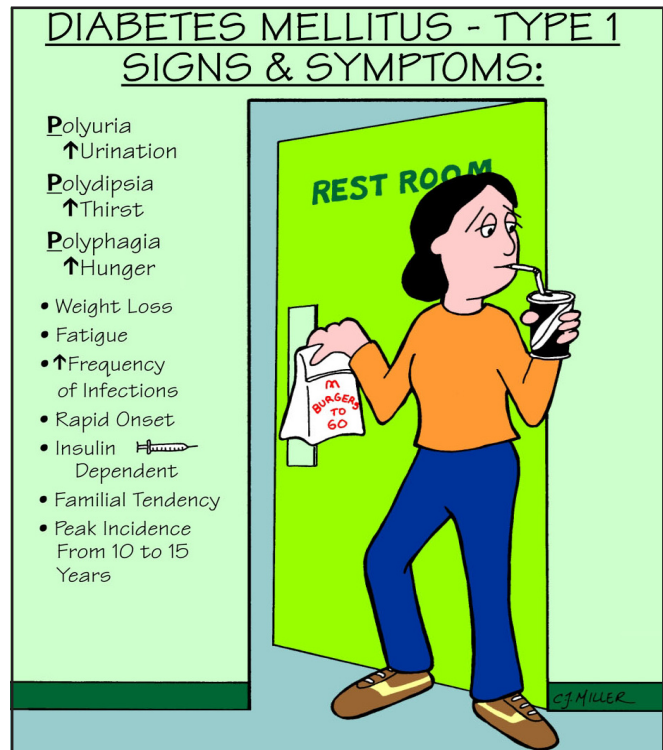
- ❖ **Goal:** To assist client to increase serum calcium levels.
  - A. Administer calcium preparations.
  - B. Evaluate increases in serum calcium levels and decreases in serum phosphate levels.
- ❖ **Goal:** To prevent complications of neuromuscular irritability.
  - A. Quiet environment.
  - B. Low lights.
  - C. Seizure precautions (Appendix 15-5).
- ❖ **Goal:** To help client avoid complications of respiratory distress.
  - A. Bronchodilators.
  - B. Tracheotomy set readily available.
  - C. Frequent assessment of respiratory status. *Immediately report any significant changes.*



## Diabetes Mellitus

\* Diabetes mellitus is a complex, multisystem disease characterized by the absence of or a severe decrease in the secretion or utilization of insulin.

- A. Pathophysiology.
  1. The primary function of insulin is to decrease the blood glucose level.



**FIGURE 8-2** Diabetes, type 1. (From Zerwekh J, Claborn J, Miller CJ: *Memory notebook of nursing*, vol 1, ed 4, Ingram, 2008, Nursing Education Consultants.)

2. Insulin is secreted by the beta cells in the islets of Langerhans in the pancreas.
  3. Insulin allows the body to use carbohydrates more effectively for conversion of glucose for energy.
  4. If carbohydrates are not available to be used for energy, cells will begin to breakdown the fats and protein stores.
    - a. Breakdown of fat results in the production of ketone bodies.
    - b. Protein is wasted during insulin deficiency and is broken down.
    - c. When fats are used as the primary energy source, the serum lipid level rises and contributes to the accelerated development of atherosclerosis.
  5. When circulating glucose cannot be utilized for energy, the level of serum glucose will increase (hyperglycemia).
- B. Classification.
1. Type 1: absolute deficiency of insulin secretion (Figure 8-2).
    - a. Onset is frequently in childhood; most often diagnosed before the age of 18 years. Most common age range is 10 to 15 years.
    - b. Previously called juvenile diabetes or insulin-dependent diabetes mellitus.
    - c. Client will have Type 1 diabetes for the rest of his or her life.

2. Type 2: combination of insulin resistance and inadequate insulin secretion to compensate (Figure 8-3).
  - a. Insulin deficiency caused by defects in insulin production or by excessive demands for insulin; client is not dependent on insulin.
  - b. Onset is predominately in adulthood, generally after the age of 40 years, but it may occur at any age.
  - c. Previously called adult onset diabetes (AODM) or noninsulin-dependent diabetes mellitus (NIDDM).
  - d. Associated with obesity; overweight people require more insulin.
  - e. May require insulin for control.
3. Gestational diabetes.
  - a. Develops during pregnancy; usually detected at 24-28 weeks gestation by oral glucose tolerance test.
  - b. Glucose tolerance usually returns to normal soon after delivery.
  - c. Commonly occurs again in future pregnancies; client is at increased risk for development of glucose intolerance and Type 2 diabetes later in life.
  - d. Infant may be large for gestational age and may experience hypoglycemia shortly after birth.

## TYPE 2 DIABETES



- Sedentary Lifestyle
- Familial Tendency
- Average Age 50 Years
- Hx of ↑ BP
- Fatigue ↓ Energy
- Obese
- Recurrent Infections
- Polyuria
- Polydipsia
- FBS > 126 mg/dl

**FIGURE 8-3 Diabetes, type 2.** (From Zerwekh J, Claborn J, Miller CJ: *Memory notebook of nursing*, vol 2, ed 3, Ingram, 2007, Nursing Education Consultants.)

### Data Collection

#### A. Clinical manifestations.

1. Types 1 and 2.
  - a. Three P's: polyphagia, polydipsia, polyuria.
  - b. Fatigue.
  - c. Increased frequency of infections.
2. Type 1.
  - a. Weight loss, excessive thirst.
  - b. Bed-wetting, blurred vision
  - c. Complaints of abdominal pain.
  - d. Onset is rapid, generally over days to weeks.
3. Type 2. (most clients asymptomatic first 5 to 10 years).

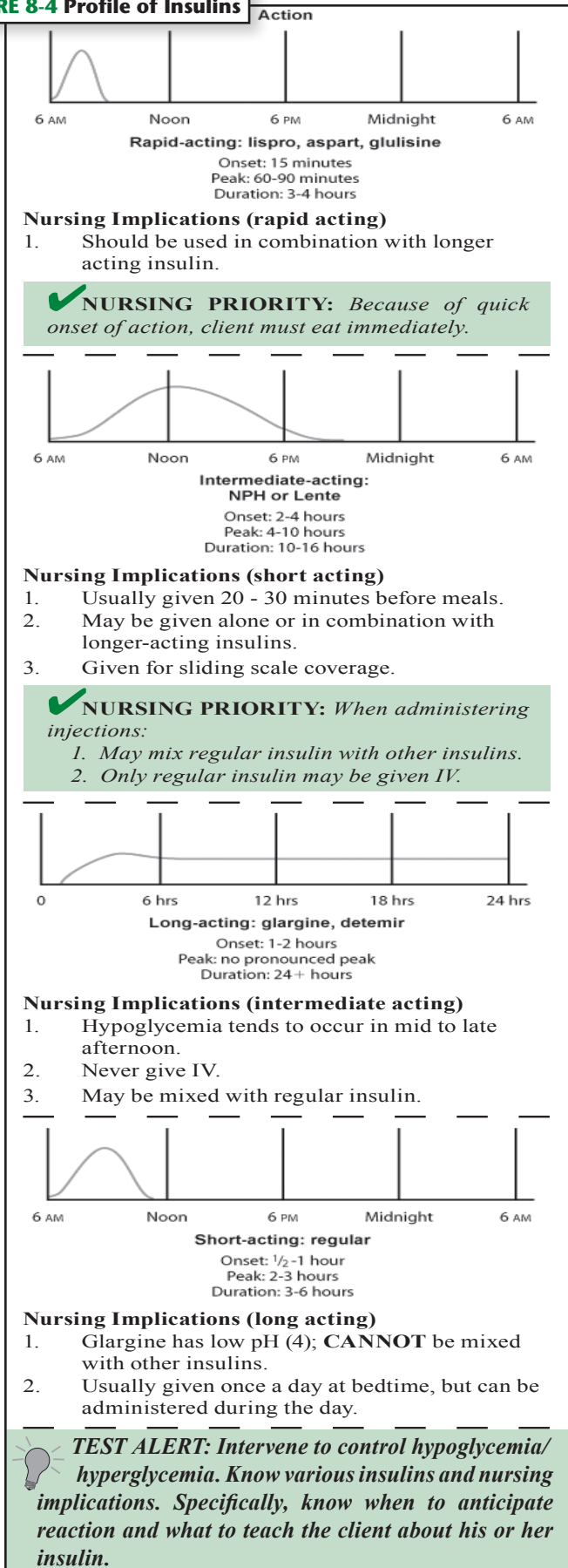
- a. Weight gain (obese), visual disturbances.
- b. Onset is slow; may occur over months.
- c. Onset usually after the age of 40 years; peaks around 45 to 50 years.
- d. Fatigue and malaise.
- e. Recurrent vaginal yeast or monilia infections - frequently initial symptom in women.
- f. Older adult assessment considerations (Box 8-1).

- #### B. Diagnostics (the criteria for diagnosis are two or more abnormal test results with two or more values outside the normal range) (see Appendix 8-1).
1. Fasting blood glucose level is above 126 mg/dl (normal glucose range 70-100 mg/dl).
  2. Glucose tolerance test: 2-hour glucose values are greater than 200 mg/dl.
  3. Random glucose greater than 200 mg/dl with symptoms (three P's, weight loss).
  4. Prediabetes – intermediate stage between normal and diabetes.
    - a. Impaired glucose tolerance (IGT): greater than 140 mg/dl and less than or equal to 200 mg/dl.
    - b. Impaired fasting glucose (IFG): fasting blood glucose greater than 100 mg/dl, but less than 126 mg/dl.
  5. Glycosylated hemoglobin (HbA<sub>1c</sub>) is increased. (Less than 7% is considered good control for diabetic; is not a test to diagnose diabetes).

### BOX 8-1 OLDER ADULT CARE FOCUS

#### Diabetic Assessment Considerations and Care

- Determine mental status and manual dexterity to handle injections.
- Determine if client can access the injection sites.
- Is client alert and mentally capable of making judgments on medications?
- Determine if the client can pay for supplies.
- What is the client's attitude about needles and injections?
- Assess how many other medications the client is taking; problems with "polypharmacy" (too many medications).
- Determine family's or client's ability to accurately perform serum glucose testing.
- What is the client's support system?

**FIGURE 8-4 Profile of Insulins**

## Treatment



- A. Hypoglycemic agents. **High Alert Medications**
- Insulin: may be used in both types of diabetes. Primary function of insulin is to transport glucose into muscle and fat cells (Figure 8-4: Profile of Insulins).
    - Combination premixed insulin therapy eliminates problem of mixing different types (example: NPH/regular 70/30 – number refers to percentage of each type of insulin).
    - Response to insulin mixtures varies with individuals.
  - Oral hypoglycemic agents for noninsulin-dependent clients (see Appendix 8-2).
- B. Diabetic diet.
- Decrease calories for weight loss.
  - Diet to meet nutritional needs and maintain optimum glucose level. Avoid simple sugars and increase dietary fiber.
  - Decrease in cholesterol level – reduce saturated and trans fat foods.
  - Decrease protein for adult due to stress that moderate to high protein places on the kidneys).
- C. Exercise - planned exercise; sporadic exercise is discouraged.

**✓ NURSING PRIORITY:** *Metabolic effects of exercise: 1. Reduces insulin needs by reducing the blood glucose. 2. Contributes to weight loss or maintenance of normal weight. 3. Assists the body to metabolize cholesterol more efficiently. 4. Promotes less extreme fluctuations in blood glucose level. 5. Decreases blood pressure.*

## Complications of Insulin Therapy

- A. Hypoglycemia (Table 8-1).
- B. Lipoatrophy (tissue atrophy) and lipohypertrophy (accumulation of extra fat at the site of many subcutaneous injections of insulin).
- C. Somogyi effect.
- Rebound hyperglycemia from an unrecognized hypoglycemic state.
  - Most often occurs at night and treated by decreasing the evening insulin dose or by increasing the calories in the bedtime snack.
- D. Dawn phenomenon
- Results from nighttime release of growth hormone and cortisol.
  - Blood glucose elevates at 5:00 to 6:00 AM (predawn hours).


**FIGURE 8-4 Insulin Profiles** (Adapted from Lewis S, Heitkemper M, Dirksen S: *Medical-surgical nursing: assessment and management of clinical problems*, “Commercially available insulin preparations showing onset, peak, and duration of action,” St Louis, 2007, Mosby).

**TABLE 8-1** COMPARISON OF DIABETIC KETOACIDOSIS (DKA) AND HYPOGLYCEMIA

	<b>DKA</b>	<b>Hypoglycemia</b>
Age	All ages, increased incidence in children.	All ages
GI	Abdominal pain, anorexia, nausea, vomiting, diarrhea	Normal; may be hungry
Mental state	Dull, confusion increasing to coma	Difficulty in concentrating, coordinating; eventually coma
Skin temperature	Warm, dry, flushed	Cold, clammy
Pulse	Tachycardia, weak	Tachycardia
Respirations	Initially deep and rapid; lead to Kussmaul respirations	Shallow
Breath odor	Fruity, acetone	Normal
Urine output	Increased	Normal
<b>Lab Values: Serum</b>		
Glucose	Greater than 300 (up to 1500 mg/dL)	Below 70 mg/dL
Ketones	High/large	Normal
pH	Acidotic (less than 7.3)	Normal
Hematocrit	High due to dehydration	Normal
<b>Lab Values: Urine</b>		
Sugar	High	Negative
Ketones	High	Negative
Onset	Rapid (less than 24 hr)	Rapid
Classification of diabetes	Primarily Type 1; Type 2 in severe distress	Type 1 and type 2

DKA, Diabetic ketoacidosis; GI, gastrointestinal

3. May be treated by increasing insulin for overnight period.
- E. Insulin requirement increases when:
1. Serious illnesses, physical trauma, and infections.
  2. Surgical procedures and growth spurts during adolescence.

 **NURSING PRIORITY:** Intensive control of blood glucose levels in clients with type 1 diabetes can prevent or ameliorate the complications. Intervene to control symptoms of hypoglycemia or hyperglycemia.

### Complications Associated with Poorly Controlled Diabetes

- A. Diabetic ketoacidosis.
  1. A severe increase in the hyperglycemic state.
  2. Occurs predominately in type 1 diabetes.
- B. Clinical manifestations of diabetic ketoacidosis (see Table 8-1).
  1. Onset - may be acute or occur over several days.
    - a. May result from stress, infection, surgery, or lack of effective insulin control.
    - b. Results from poorly controlled diabetes.
  2. Severe hyperglycemia (blood glucose levels of 300-800 mg/dL).
  3. Presence of metabolic acidosis (low pH [6.8-7.3] and serum bicarbonate level less than 15 mEq/L).

4. Hyperkalemia, hypokalemia, or normal potassium level, depending on amount of water loss.
  5. Urine ketone and sugar levels are increased.
  6. Excessive weakness, increased thirst.
  7. Nausea, vomiting, dehydration.
  8. Increased temperature caused by dehydration.
  9. Fruity (acetone) breath, Kussmaul respirations.
  10. Decreased level of consciousness.
- C. Hyperosmolar hyperglycemia syndrome (HHS). Also known as Nonketotic Hyperosmolar Coma and/or Hyperosmolar Hyperglycemic State (see Table 8-1).
1. Occurs in the adult (older adult) with Type 2 diabetes.
  2. Characterized by extreme hyperglycemia (400-1200 mg/dl) without acidosis.

### Complications of Long-Term Diabetes

- A. Angiopathy: premature degenerative changes in the vascular system.
  1. May affect large vessels as in peripheral vascular disease: decreased circulation to lower extremities.
  2. May affect smaller vessels of the kidney, resulting in nephropathy and renal failure.
  3. May affect small vessels of the retina, resulting in blurred vision, retinopathy, cataracts.
  4. Acceleration of atherosclerotic process, resulting in hypertension.





### BOX 8-2 IMPLICATIONS IN THE ADMINISTRATION OF INSULIN

1. Do not administer cold insulin; it increases pain and causes irritation at injection site.
2. An open 10-mL vial of unrefrigerated insulin should be discarded after 30 days, regardless of how much was used.
3. Do not allow insulin to freeze and keep it away from heat and sunlight.
4. Insulin pens (NPH and 70/30) should be discarded after 1 week of storage at room temperature. Regular cartridges, which don't contain preservatives, may be left unrefrigerated for up to 1 month.
5. Extreme temperatures (less than 36° F or greater than 86° F) should be avoided.
6. Roll the vial between the palms of the hands to decrease the risk of inconsistent concentration of insulin.
7. The abdomen is the primary site for subcutaneous injections of insulin. Rotate injection sites; injection sites should be 1 inch apart.
8. Abdomen area provides most rapid insulin absorption.
9. Use only insulin syringes to administer insulin.
10. Check expiration date on insulin bottle.
11. When drawing up regular insulin with a long-acting insulin, draw up the regular (clear) insulin before the longer-acting (cloudy) insulin.
12. Regular insulin is used for administration by sliding scale and periods when blood sugar is unstable and difficult to control.
13. Using alcohol to cleanse the skin before injection is not recommended. If used, hold alcohol pad in place for a few seconds but do not massage.
14. Aspirating is not recommended for self-injection.
15. Check dose with another nurse prior to administering.

- B. Nerve damage resulting in neuropathy.
1. Peripheral neuropathy: pain and tingling in legs and feet; may progress to painless neuropathy.
  2. Very common complication.
- C. Infections: Immune system is altered; persistent glycosuria potentiates urinary tract infections.

**NURSING PRIORITY:** Painless peripheral neuropathy is a very dangerous situation for the diabetic. Severe injury to the lower extremities may occur, and the client will not be aware of it. Clients should be taught to visually inspect their feet and legs.

#### Clinical Implications of Diabetes in Pregnancy

- A. During the second and third trimester, the *normal* response is for the insulin needs to increase as much as 70% to 100%.
- B. Failure of insulin needs to increase may be indicative of placental insufficiency.

- C. There is an increased tendency toward the development of metabolic acidosis.
- D. There is a tendency to intensify the existing complications of diabetes.
- E. Oral hypoglycemic agents are not used to control diabetes in the pregnant client – insulin is used.

#### Nursing Intervention (All Types)

- ❖ **Goal:** To return serum glucose to normal level.
- A. Initially administer regular insulin on a proportional basis according to need (Box 8-2).
- B. Administer insulin 30 minutes before a meal or snack.
- C. Maintain adequate fluid intake.
- D. Evaluate serum electrolyte levels, especially potassium.
- E. Evaluate hydration status.
- F. *Evaluate and report clinical manifestations of hypoglycemia and hyperglycemia.*



**TEST ALERT:** Monitor hydration status and electrolyte balance.

- ❖ **Goal:** To plan and implement a teaching regimen.
- A. Assess current level of knowledge regarding diabetes.
- B. Evaluate cultural and socioeconomic parameters.
- C. Evaluate client's support system (family, significant others).
- D. Instruct regarding sick-day guidelines (Box 8-3).



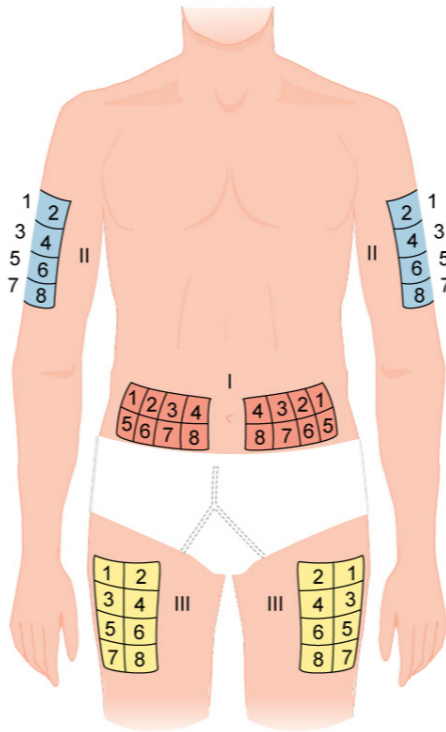
**TEST ALERT:** Determine ability of family/support systems to provide care for client. Identify client's and family's strengths.

- E. Administration of insulin (see Box 8-2).
1. Correct injection techniques.
  2. Rotate injection site (Figure 8-5).
  3. Check expiration date on the insulin.
  4. Duration and peak action of prescribed insulin.
  5. Allow for ample practice time.
  6. Administer at the same time each day.

### BOX 8-3 OLDER ADULT CARE FOCUS

#### Guidelines for Food Selection

- Avoid canned fruits that are in heavy syrup; select fruit packed in water.
- Include fresh fruits and vegetables and whole-grain cereals and breads to provide adequate dietary fiber to prevent constipation.
- Avoid casseroles, fried foods, sauces and gravies, and sweets.
- Fats (oils, margarines) that are liquid at room temperature are better than those that are solid.
- Read food labels: the highest-content ingredient is listed first.
- Select foods in which the majority of calories do not come from a fat source.



**FIGURE 8-5 Sites Used for Insulin Injection.** The injection site can affect the onset, peak, and duration of action of the insulin. Insulin injected into the abdomen (area I) is absorbed fastest, followed by insulin injected into the arm (area II) and the leg (area III). (From Black J, Hawks, J: *Medical surgical nursing: clinical management for positive outcomes*, ed 8, St Louis, 2009, Mosby.)

7. Clients following an intensive diabetes therapy program may choose to use an insulin pump or to monitor blood glucose levels four to six times a day and take injections at those times.
    - a. The insulin pump is battery operated; insertion site is changed every 2 to 3 days; pump is re-filled and reprogrammed when site is changed.
    - b. Delivers continuous infusion of short-acting insulin over a 24-hour period, allowing for tight glucose control.
    - c. Can deliver bolus of insulin based on excessive carbohydrates ingested.
    - d. Monitor insertion site for redness and swelling.
  8. Insulin pen is a compact portable device that is loaded with insulin; need to change needle with each injection.
- F. Oral hypoglycemic agents.
1. Take medication as scheduled; do not skip or add dose.
  2. Signs and symptoms of hypoglycemia.
  3. Anticipate change in medication with pregnancy.
- G. Monitoring blood glucose.
1. Self-monitoring of blood glucose (SMBG) – not necessary to use alcohol to cleanse site.
  2. Use side of finger pad rather than near the center. If alternative site use (i.e., forearm), may require different equipment.
  3. Need only a large drop of blood.
- H. Exercise.
1. Establish an exercise program.
  2. Avoid sporadic exercise.
  3. Review instructions regarding adjustment of insulin and food intake to meet requirements of increased activity.
  4. Extremities involved in activity should not be used for insulin injection (e.g., arms when playing tennis).
- I. Diet (Box 8-4).
1. Regularly scheduled mealtimes.
  2. Understanding of food groups and balanced nutrition.
  3. Incorporate family tendencies and cultural patterns into prescribed dietary regimen.
  4. Provide client and family with written instructions regarding dietary needs.
- J. Infection control.
1. Report infections promptly.
  2. Insulin requirements may increase with severe infections.
  3. Increased problems with vaginitis, urinary tract infections, and skin irritation.
- K. Avoid injury.
1. Decreased healing capabilities, especially in lower extremities.
  2. Maintain adequate blood supply to extremities; avoid tight-fitting clothing around the legs.
  3. Proper foot care (see Chapter 11).
- ❖ **Goal:** To prepare the diabetic client for surgery.
- A. Oral hypoglycemic agents should not be given the morning of surgery.
- B. For clients with NPO (nothing by mouth) status who require insulin, an IV of 5% dextrose in water (D<sub>5</sub>W) is frequently started.
- C. Obtain a blood glucose reading about an hour before sending the client to surgery to make sure he or she is not developing hypoglycemia.

✓ **NURSING PRIORITY:** Evaluate intake; do not give client on NPO status insulin unless IV is in place.

- ❖ **Goal:** To maintain control of diabetic condition in the postoperative client.
- A. IV fluids and regular insulin until client is able to take fluids orally.
  - B. Frequent blood sugar level assessment.
  - C. Observe for hypoglycemia immediately after surgery.
- ❖ **Goal:** To identify diabetic ketoacidosis and assist client to return to homeostasis.
- A. Frequent monitoring of vital signs and serum glucose checks (normally hourly).
  - B. Hourly urine measurements: Do not administer potassium if urine output is low or dropping.

## BOX 8-4

## DIABETIC "SICK DAY" GUIDELINES

*If you do not feel well (not eating regularly, fever, lethargy, nausea and vomiting, etc.):*

1. Check your blood glucose every 3 to 4 hours and urine ketones when voiding.
2. Increase your intake of fluids that are high in carbohydrates; every hour, drink fluids that replace electrolytes: fruit drinks, sports drinks, regular soft drinks (not diet beverages).
3. If you cannot eat and you have replaced four to five meals with liquids, notify your health care provider.
4. Get plenty of rest; if possible, have someone stay with you.
5. Do not omit or skip your insulin injections or oral medications unless specifically directed to do so by your health care provider.
6. Follow your health care provider's instructions regarding blood glucose levels and insulin or oral hypoglycemic agents.
7. Stay warm, stay in bed, and do not overexert yourself.
8. Call your health care provider when:
  - a. You have been ill for 1 to 2 days without getting any better.
  - b. You have been vomiting or had diarrhea for more than 6 hours.
  - c. Your urine self-testing shows moderate to large amounts of ketones.
  - d. You are taking insulin and your blood glucose level continues to be greater than 240 mg/dl after you have taken two to three supplemental doses of regular insulin (pre-arranged with your provider).
  - e. You are taking insulin and your blood glucose level is less than 60 mg/dl.
  - f. You have Type 2 diabetes, you are taking oral diabetic medications, and your premeal blood glucose levels are 240 mg/dl or greater for more than 24 hours.
  - g. You have signs of severe hyperglycemia (very dry mouth or fruity odor to breath), dehydration, or confusion.
  - h. You are sleepier or more tired than normal.
  - i. You have stomach or chest pain or any difficulty breathing.
  - j. You have any questions or concerns about what you need to do while ill.



## Home Care

- A. Maintain optimum weight.
- B. Continue to receive long-term medical care.
- C. Notify all health care providers of diagnosis of diabetes; wear medical alert identification.
- D. Recognize problems of the cardiovascular system.
  1. Peripheral vascular disease.
  2. Decreased healing.
  3. Increased risk of stroke.
  4. Increased risk of myocardial infarction.

5. Presence of retinopathy.
  6. Increased risk of renal disease.
- E. Recognize problems of peripheral neuropathy.



**OLDER ADULT PRIORITY:** Assess client's ability to take medications correctly and/or client's manual dexterity to handle insulin syringe and visual acuity to measure correct dose.

- ❖ **Goal:** To assist the diabetic client to maintain homeostasis throughout pregnancy.
- A. Prevent infection.
  - B. Frequent evaluation of glucose levels and monitoring of changes in insulin requirements.
  - C. Maintain optimum level of weight gain; labor may be induced or cesarean delivery may be required if complications are evident.



## Hypoglycemia (Insulin Reaction)

\* **Hypoglycemia is a condition characterized by a decreased serum glucose level, which results in decreased cerebral function.**

## Data Collection

- A. Lability of mood.
- B. Emotional changes, confusion.
- C. Headache, lightheadedness, seizures, coma.
- D. Impaired vision, tachycardia, hypotension.
- E. Nervousness, tremors, diaphoresis.
- F. Serum glucose below 50 mg/dL.
- G. Negative urine acetone test result.

## Treatment

- A. Carbohydrates by mouth if client is alert and can swallow.
  1. Milk preferred in children with a mild reaction; it provides immediate lactose, as well as protein and fat for prolonged action.
  2. Simple sugars for immediate response: orange juice, honey, candy, glucose tablets.
- B. Glucagon can be given intravenously if client is unconscious.

## Nursing Intervention

- ❖ **Goal:** To increase serum glucose level.
- A. Administer glucose/carbohydrate preparations as indicated.



**NURSING PRIORITY:** When in doubt of diagnosis of hypoglycemia versus hyperglycemia, administer carbohydrates; severe hypoglycemia can rapidly result in permanent brain damage.

- B. Thorough assessment of the diabetic client for the development of hypoglycemia.
- ❖ **Goal:** To assist client to identify precipitating causes and activities to prevent the development of hypoglycemia.
- A. Instruct the diabetic client to carry simple carbohydrates.
- B. Administer between-meal snacks at the peak action of insulin.
- C. Between-meal snacks should limit simple carbohydrates and increase complex carbohydrates and protein.
- D. Client should carry some type of medical alert identification.



### Pancreatitis

\* **Pancreatitis is an inflammatory condition of the pancreas that results in autodigestion of the pancreas by its own enzymes.**

#### Data Collection

- A. Severe constant midepigastric pain.
  1. Radiates to the back or flank area.
  2. Exacerbated by eating.
- B. Acute.
  1. Persistent vomiting, low-grade fever.
  2. Hypotension and tachycardia.
  3. Jaundice, if common bile duct is obstructed.
  4. Abdominal distention.
- C. Chronic.
  1. Decrease in weight, mild jaundice.
  2. Steatorrhea (fatty stools), hyperglycemia.
  3. Abdominal distention and tenderness.
- D. Increase in serum amylase and lipase levels.

#### Treatment

- A. Opioid analgesics.
- B. Antibiotics, smooth muscle relaxants.
- C. Decrease pancreatic stimulus.
  1. NPO status; IV fluids.
  2. Nasogastric suction, bed rest.
  3. Diet: (if not NPO) low-fat, high-carbohydrate.
- D. Surgical intervention to eliminate precipitating cause (biliary tract obstruction).

#### Nursing Intervention

Nursing intervention is the same for the client with acute pancreatitis and for the client with chronic pancreatitis experiencing an acute episode.

- ❖ **Goal:** To relieve pain and decrease pancreatic stimulation.
- A. Administer analgesics; pain control is essential (restlessness may cause pancreatic stimulation and further secretion of enzymes).
- B. Place client on side in knee-chest or in semi-Fowler's position.
- C. Evaluate precipitating cause.

- D. Maintain NPO status initially.
- E. Maintain nasogastric suctioning.
- F. Small frequent feedings when food is allowed.
- ❖ **Goal:** To prevent complications.
- A. Monitor fluid and electrolyte imbalances especially hypocalcemia and hydration.
- B. Maintain respiratory status; problems occur because of pain and ascites.
- C. Assess for hyperglycemia and development of diabetes.



### Home Care

- A. Avoid all alcohol intake.
- B. Know signs of development of diabetes and when to return for evaluation of blood sugar level.
- C. Bland diet, low in fat, high in carbohydrates (protein recommendations vary).
- D. Replacement of pancreatic enzymes.



### Cancer of the Pancreas

\* **The majority of tumors occur in the head of the pancreas. As tumors grow, the bile ducts are obstructed, causing jaundice. Tumors in the body of the pancreas frequently do not cause symptoms until growth is advanced. Cancer of the pancreas has a poor prognosis; the 5 year survival rate is low.**

#### Data Collection

- A. Dull, aching abdominal pain.
- B. Ascites, nausea, vomiting.
- C. Anorexia and progressive weight loss.
- D. Jaundice, clay-colored stools,
- E. Dark, frothy urine.

#### Treatment

- A. Surgery: Whipple's procedure (radical pancreatic duodenectomy).
- B. Radiation therapy.
- C. Chemotherapy.

#### Nursing Intervention

- ❖ **Goal:** To maintain homeostasis (see nursing intervention for pancreatitis).
- ❖ **Goal:** To provide preoperative nursing measures if surgery is indicated.
- A. Maintain nasogastric suctioning; assess for adequate hydration.
- B. Control hyperglycemia.
- C. Assess cardiac and respiratory stability.
- D. Assess for development of thrombophlebitis.
- ❖ **Goal:** To promote comfort, prevent complications, and maintain homeostasis in client who has undergone Whipple's procedure.
- A. General postoperative care (see Chapter 3).



- B. Evaluate for bleeding tendencies caused by decreased prothrombin activity.
- C. Monitor for fluctuation in serum glucose levels.
- D. Maintain NPO status and nasogastric suction until peristalsis returns.
- E. Encourage adequate nutrition when appropriate.
  1. Decrease fats and increase carbohydrates.
  2. Small, frequent feedings.



### Home Care

- A. Evaluate for bouts of anxiety and depression caused by severity of illness and prognosis (see Chapter 6).
- B. Assist client in setting realistic goals.
- C. Encourage ventilation of feelings.



### Pheochromocytoma

\* **Pheochromocytoma is a rare disorder of the adrenal medulla characterized by a tumor that secretes an excess of epinephrine and norepinephrine.**

#### Data Collection

✓ **NURSING PRIORITY:** Clients experiencing problems of the adrenal medulla have severe fluctuations in blood pressure related to the levels of catecholamines.

- A. Persistent or paroxysmal hypertension.
- B. Palpitations, tachycardia.
- C. Hyperglycemia, headache.

#### Treatment

- A. Medications - antihypertensive medications.
- B. Surgery: removal of the tumor is the treatment of choice.

#### Nursing Intervention

❖ **Goal:** To decrease client's hypertension and provide preoperative nursing measures as appropriate (see Chapter 3).

- A. Decrease intake of stimulants.
- B. Assess vital signs frequently.

❖ **Goal:** To assist client to return to homeostasis after adrenalectomy.

- A. Maintain normal blood pressure the first 24 to 48 hours after surgery; client is at increased risk for hemorrhage or severe hypotensive episode.
  1. Assess for blood pressure changes caused by catecholamine imbalance (both hypertension and hypotension).
  2. Administer analgesics judiciously.
  3. Administer corticosteroids as indicated.

❖ **Goal:** To maintain health after adrenalectomy.

- A. Continued medical follow-up care.
- B. If both adrenals are removed, client will require lifelong replacement of adrenal hormones.



### Addison's Disease (Adrenocortical Insufficiency/Adrenal Hypofunction)

\* **Addison's disease is caused by a decrease in secretion of the adrenal cortex hormones.**

#### Data Collection

- A. Fatigue, weakness.
- B. Weight loss, bronze pigmentation of the skin.
- C. Postural hypotension.
- D. Hyponatremia, hyperkalemia.
- E. Hypoglycemia.
- F. Adrenal crisis (Addisonian crisis) – may be caused by client failing to take medications.
  1. Profound fatigue, dehydration.
  2. Vascular collapse (see cyanosis and signs of shock: pallor, anxiety, weak/rapid pulse, tachypnea, and low blood pressure).



**TEST ALERT:** Determine if vital signs are abnormal (e.g., hypotension, hypertension); notify others of change in client's condition.

#### Treatment

- A. Replace adrenal hormones.
- B. May require lifelong replacement of adrenal hormones.

#### Nursing Intervention

❖ **Goal:** To return to homeostasis.

- A. Initiate and maintain IV infusion of normal saline solution.
- B. Administer large doses of corticosteroids through IV bolus initially, then titrate in a diluted solution.
- C. Frequent evaluation of vital signs.
- D. Assess sodium and water retention.
- E. Evaluate serum potassium levels.
- F. Keep client immobilized and quiet.



**NURSING PRIORITY:** If any client is experiencing difficulty with maintaining adequate blood pressure, do not move him or her unless absolutely necessary. Avoid all unnecessary nursing procedures until the client's condition is stabilized.


❖ **Goal:** To safely take steroid replacements (see Appendix 5-7).

- A. Administer steroid preparations with food or an antacid.
- B. Evaluate for edema and fluid retention.
- C. Assess serum sodium and potassium levels.
- D. Check daily weight.
- E. Increase intake of protein and carbohydrates.
- F. Evaluate for hypoglycemia.
- G. Observe for cushingoid symptoms.



### Home Care

- A. Lifelong steroid therapy is necessary.
- B. Dosage of steroids may need to be increased in times of additional stress.
- C. Infection, diaphoresis, and injury will necessitate an increase in the need for steroids and may precipitate a crisis state.
- D. Report gastric distress because it may be caused by steroids.
- E. Carry a medical identification card.



### Cushing's Syndrome (Adrenal cortex hypersecretion/Hypercortisolism)

\* **Cushing's syndrome occurs as a result of excess levels of adrenal cortex hormones.**

✓ **NURSING PRIORITY:** *The most common cause of Cushing's syndrome is long-term steroid therapy for chronic conditions. Many chronic conditions necessitate the use of long-term steroid therapy. The symptoms of the syndrome are the same regardless of the origin of the problem.*

### Data Collection

- A. Marked change in personality (emotional lability), irritability.
- B. Changes in appearance.
  1. Moon face.
  2. Deposit of fat on the back.
  3. Thin skin, purple striae.
  4. Truncal obesity with thin extremities.
  5. Bruises and petechiae.
- C. Persistent hyperglycemia.
- D. GI distress from increased acid production.
- E. Osteoporosis.
- F. Increased susceptibility to infection.
- G. Sodium and fluid retention; potassium depletion.
- H. Hypertension.
- I. Changes in secondary sexual characteristics.
  1. Amenorrhea (females).
  2. Hirsutism (females).
  3. Gynecomastia (males).
  4. Impotence or decreased libido.

### Treatment

Treatment depends on the cause of the problem. Cushing's syndrome is most often caused by the intake of steroid medications required to treat a chronic condition (e.g., arthritis, pulmonary inflammation, transplants), and control of the condition requires the client to stay on the medications. At that point, treatment of the condition is supportive.

### Nursing Intervention

❖ **Goal:** To assist in return to hormone balance.

- A. Restrict sodium and water intake.
- B. Monitor fluid and electrolyte levels.
- C. Evaluate for hyperglycemia.
- D. Assess for GI disturbances.
- E. Prevent infection.

❖ **Goal:** To prevent complications.

- A. Excessive sodium and water retention: monitor for edema, hypertension, heart failure.
- B. Potassium depletion: monitor for cardiac arrhythmias.
- C. Evaluate client's ability to cope with change in body image.
- D. Predisposed to fractures; promote weight bearing; monitor for joint and bone pain; promote home safety.



### Home Care


- A. Stress the need for continuous health care.
- B. Encourage continuation of activities.
- C. Have client demonstrate an understanding of the medication regimen.
- D. Assist client to identify methods of coping with problems of therapy.
- E. Have client demonstrate an understanding of specific problems for which he or she needs to notify the physician.

### Study Questions: Endocrine System

1. The nurse is evaluating a client with diabetic ketoacidosis. The nurse would note which respiratory pattern as indicative of complications associated with this condition?
  - 1 Rapid and deep respirations.
  - 2 Rapid and shallow respirations.
  - 3 Normal with sleep apnea.
  - 4 Cheyne-Stokes respirations.
2. A client in the emergency department has a blood glucose of 40mg/mL. The nurse would anticipate which medication to be ordered?
  - 1 NPH insulin.
  - 2 Metformin (**Glucophage**).
  - 3 Regular insulin.
  - 4 Glucagon.
3. A client is placed on insulin sliding scale. The nurse would anticipate which medication needing to be administered?
  - 1 Lente insulin.
  - 2 Regular insulin.
  - 3 NPH insulin.
  - 4 Glargine insulin.
4. While gathering information on a diabetic client, the nurse smells a sweet, fruity odor. What would be important for the nurse to check?
  - 1 Serum blood glucose level.
  - 2 Blood urea nitrogen level.
  - 3 Ketostix of the urine.
  - 4 Urinary output.
5. A client has an order for a glycosylated hemoglobin test to be done. The nurse understands that the purpose of this test is to:
  - 1 Determine the glucose levels over the past 120 days.
  - 2 Evaluate the blood glucose level after a 24-hour fasting.
  - 3 Determine the level of insulin present in the body.
  - 4 Evaluate the function of the pancreas.
6. What would be noted on the assessment of a client with hyperthyroidism?
  - 1 Dry skin, bradycardia, and hypertension.
  - 2 Difficulty staying awake, increased appetite, and weight gain.
  - 3 Marked weight gain, hypertension, and tachycardia.
  - 4 Increased activity, difficulty sleeping, and weight loss.
7. The nurse is caring for a client who is 8-hours post-thyroidectomy. What are important nursing interventions for this client? Select all that apply:
  - 1 Have the client speak every 2 hours to determine increasing level of hoarseness.
  - 2 Provide a high-calcium diet to replace calcium lost during the procedure.
  - 3 Evaluate behind the neck for the presence of blood from the incision.
  - 4 Assist client to perform range-of-motion neck exercises to prevent contractures.
  - 5 Maintain the client in semi-Fowler's position.
  - 6 Check the incision for formation of a hematoma.
8. A client is admitted with a diagnosis of Cushing's syndrome. What is an important consideration for the nurse to make in caring for this client?
  - 1 The client is going to be intolerant of heat, and pulse rate and blood pressure will be increased.
  - 2 Due to decreased inflammatory response, the client will be at increased risk for infection.
  - 3 It is important to maintain strict intake and output due to hypovolemia.
  - 4 Due to activity intolerance, the client will be kept on bed rest and a high-sodium diet will be prescribed.
9. The nurse is caring for a client who has Addison's disease. How will the nurse evaluate the client for complications associated with this condition?
  - 1 Evaluate the client for the presence of fluctuating blood pressure readings.
  - 2 Assess for the development of fever and purulent drainage.
  - 3 Perform frequent respiratory checks for decreased movement of air.
  - 4 Maintain strict intake and output records to determine compromised renal function.
10. A diabetic client comes into the emergency department with a diagnosis of diabetic ketoacidosis. The nurse would anticipate what symptoms with this client?
  - 1 Shallow respirations, bradycardia, confusion.
  - 2 Pallor, diaphoresis, tachycardia.
  - 3 Low blood pressure, diaphoresis, nausea and vomiting.
  - 4 Rapid and deep respirations, tachycardia, confusion.
11. Which client would be most likely to be able to control their diabetes through diet and exercise?
  - 1 A 10-year-old child.
  - 2 A 30-year-old woman with onset at age 11 years.
  - 3 A 1-year-old child.
  - 4 A 60-year-old woman with onset at age 45 years.
12. When a client returns to his room following a thyroidectomy, what equipment is important for the nurse to have readily available?
  - 1 Oral airway.
  - 2 Tracheotomy tray and suction.
  - 3 Paper and pencil.
  - 4 A small cassette tape recorder.

*Answers and rationales to these questions are in the section at the end of the book titled Chapter Study Questions: Answers and Rationales.*

## Appendix 8-1 ENDOCRINE DIAGNOSTICS

Diagnostic Test	Normal	Clinical/Nursing Implications
<b>THYROID</b>		
Thyroxine (T <sub>4</sub> )	5-12 mcg/dl	1. Increased in hyperthyroidism, decreased in hypothyroidism
Triiodothyronine (T <sub>3</sub> )	70-220 ng/dl	2. When T <sub>3</sub> & T <sub>4</sub> are low, TSH secretion increases.
Thyroid-stimulating hormone (TSH)	0.2-5.4 mIU/L	3. TSH is increased in hypothyroidism and decreased in hyperthyroidism.
<b>PANCREAS</b>		
Serum glucose	60-110 mg/dl	1. Test is timed to rule out diabetes by determining rate of glucose absorption from serum.
Oral glucose tolerance test	1 hr: less than 200 mg/dl 2 hr: less than 140 mg/dl	2. In healthy person, insulin response to large dose of glucose is immediate. 3. Insulin and oral hypoglycemic agents should not be administered before test.
Glucose fasting blood sugar (FBS) Also called: fasting blood glucose (FBG) and fasting plasma glucose (FPG)	Same as serum glucose (consistently greater than 126 mg/dl is diagnostic for diabetes)	1. Used as a screening test for problems of metabolism. 2. Maintain client in fasting state for 12 hours until blood is drawn. 3. If client is a known diabetic and experiences dizziness, weakness, or fainting, draw blood for determination of glucose level.
Glycosylated hemoglobin (HbA <sub>1c</sub> )	Nondiabetic usually 4%-6%. 2%-6.4% considered good diabetic control (goal is 7% or less) greater than 8% considered poor diabetic control	1. More accurate test of diabetic control, because it measures glucose attached to hemoglobin (indicates overall control for past 90-120 days, which is the lifespan of the RBC).
 <b>TEST ALERT:</b> Frequently, the level of the FBS is given in a question, and it is necessary to evaluate the level and determine the appropriate nursing intervention.		
2-Hour postprandial blood sugar	65-139 mg/dl	1. Involves measuring the serum glucose 2 hours after a meal; results are significantly increased in diabetic.
Serum amylase	30-200 U/L	1. Used to evaluate pancreatic cell damage. 2. Other intestinal conditions and inflammatory conditions cause increase.
Serum lipase	Normal values vary with method; elevated is abnormal	1. Appears in serum after damage to pancreas.
Urine sugar (Clinistix, Clinitest, Labstix)	Negative for glucose	1. Use fresh double-voided specimen. 2. A rough indicator of serum glucose levels. 3. Results may be altered by various medications.
Ketone bodies (acetone)	Negative	1. Ketone bodies occur in the urine before there is significant increase in serum ketones. 2. Use freshly voided urine.
<b>PITUITARY</b>		
Growth hormone (GH)	Less than 5 ng/mL in men Less than 18 ng/mL in women	1. NPO after midnight. 2. Maintain bed rest until serum sample is drawn.
<b>ADRENAL MEDULLA</b>		
Urinary vanillylmandelic acid (VMA)	Less than 8 mg in 24 hr Increased with pheochromocytoma	1. Depending on how test is measured, there may be dietary and medication restrictions. 2. 24-hr urine collection.
ACTH stimulation test	Increase in plasma cortisol levels by more than 7-10 mcg/dl above baseline	1. ACTH is given as IM or IV bolus and samples are drawn at 30 and 60 min to evaluate ability of adrenal glands to secrete steroids.
<b>ADRENAL CORTEX</b>		
ACTH suppression (dexamethasone suppression test)	Normal suppression; 50% decrease in cortisone production (cortisol level less than 3 mcg/dl)	1. An overnight test: A small amount of dexamethasone is administered in the evening, and serum and urine are evaluated in the morning; extensive test may cover 6 days. 2. Cushing's syndrome is ruled out if suppression is normal.
Plasma cortisol levels for diurnal variations	Secretion high in early morning, decreased in evening. 8:00 AM: 5-23 mcg/dl 4:00 PM: 3-13 mcg/dl	1. Elevation in plasma cortisol levels occurs in the morning and significant decrease in evening and night—a diurnal variation.
24-Hour urine for 17-hydroxycorticosteroids and 17-ketosteroids	Male: 3-10 mg/24 hr Female: 2-8 mg/24 hr Child under 15 yr: less than 4.5 mg/24 hr	1. Increase in urine levels indicates hyperadrenal function. 2. Keep specimen refrigerated

ACTH, Adrenocorticotropic hormone; ADH, antidiuretic hormone; NPO, nothing by mouth; RBC, red blood cell.





## Appendix 8-2 MEDICATIONS USED IN ENDOCRINE DISORDERS

Medications	Side Effects	Nursing Implications
<b>ADH REPLACEMENT</b>		
Desmopressin ( <b>DDAVP</b> ): nasal spray, PO, IV, SQ Vasopressin ( <b>Pitressin</b> ): IM, SQ Lypressin ( <b>Diapid</b> ): nasal spray	Excessive water retention, headache, nausea, flushing.	<ol style="list-style-type: none"> <li>1. Monitor daily weight; correlate with intake and output.</li> <li>2. Vasopressin more likely to cause adverse cardiovascular and thromboembolic problems.</li> </ol>
<b>ANTITHYROID AGENT: Inhibits production of thyroid hormone; does not inactivate thyroid hormone in circulating blood. Medications are not reliable for long-term inhibition of thyroid hormone production.</b>		
Propylthiouracil ( <b>PTU</b> ): PO	Agranulocytosis; abdominal discomfort; nausea, vomiting, diarrhea; crosses placenta.	<ol style="list-style-type: none"> <li>1. May increase anticoagulation effect of heparin and oral anti-coagulants.</li> <li>2. May be combined with iodine preparations.</li> <li>3. Monitor CBC.</li> <li>4. Store Tapazole in light-sensitive container.</li> <li>5. May be used before surgery or treatment with radioactive iodine.</li> </ol>
Methimazole ( <b>Tapazole</b> ): PO	Same; crosses placenta more rapidly.	
Lugol's solution: PO Saturated solution of potassium iodide ( <b>SSKI</b> )	Inhibits synthesis and release	<ol style="list-style-type: none"> <li>1. Administer in fluid to decrease unpleasant taste. of thyroid hormone.</li> <li>2. May be used to decrease vascularity of thyroid gland before surgery.</li> </ol>
<b>RADIOACTIVE IODINE: Accumulates in the thyroid gland; causes partial or total destruction of thyroid gland through radiation.</b>		
Iodine ( $I^{123}$ or $I^{131}$ ): PO	Discomfort in thyroid area; bone marrow depression. Desired effect: permanent hypothyroidism.	<ol style="list-style-type: none"> <li>1. Increase fluids immediately after treatment, because radioactive isotope is excreted in the urine.</li> <li>2. Therapeutic dose of radioactive iodine is low; no radiation safety precautions are required.</li> <li>3. Contraindicated in pregnancy.</li> </ol>
<b>THYROID REPLACEMENTS: Replacement of thyroid hormone.</b>		
Levothyroxine sodium ( <b>Levothroid, Levoxyl, Levo-T, Novothyrox, Synthroid</b> ): PO, IM, IV	Overdose may result in symptoms of hyperthyroidism: tachycardia, heat intolerance, nervousness.	<ol style="list-style-type: none"> <li>1. Be careful in reading exact name on label of medications; micrograms and milligrams are used as units of measure.</li> <li>2. Generally taken once a day before breakfast.</li> <li>3. Within 3-4 days, begin to see improvement; maximum effect in 4-6 weeks.</li> </ol>
Liothyronine ( <b>Cytomel, Triostat</b> )		
<b>PANCREATIC ENZYMES: Replacement enzyme to aid in digestion of starch, protein, and fat.</b>		
Pancreatin ( <b>Creon</b> ): PO	GI upset and irritation of mucous membranes.	<ol style="list-style-type: none"> <li>1. Client is usually on a high-protein, high-carbohydrate, low-fat diet.</li> <li>2. Enteric-coated tablets should not be crushed or chewed.</li> <li>3. Pancreatin may be given before, during, or within 1 hr after PO meals.</li> <li>4. Pancrelipase is given just before or with each meal or snack.</li> </ol>
Pancrelipase ( <b>Pancrease, Pangestyme, Ultrase, Viokase</b> ): PO meals.		
<b>ANTIHYPOGLYCEMIC AGENT: Increases plasma glucose levels and relaxes smooth muscles.</b>		
Glucagon: IM, IV, SQ	Possible rebound hypoglycemia.	<ol style="list-style-type: none"> <li>1. Watch for symptoms of hypoglycemia and treat with food first, if conscious.</li> <li>2. Client usually awakens in 5-20 min after receiving Glucagon.</li> <li>3. If client does not respond, anticipate IV glucose to be given.</li> </ol>
<b>ORAL HYPOGLYCEMIC AGENTS: Stimulate beta cells to secrete more insulin; enhance body utilization of available insulin (see Figure 8-4 for insulin). HIGH ALERT MEDICATIONS</b>		
<b>GENERAL NURSING IMPLICATIONS</b>		
<ul style="list-style-type: none"> <li>• Dose should be decreased for elderly.</li> <li>• Use with caution in clients with renal and hepatic impairment.</li> <li>• All oral hypoglycemic agents are contraindicated in pregnant clients.</li> <li>• All clients should be carefully observed for symptoms of hypoglycemia and hyperglycemia.</li> <li>• Medications should be taken in the morning.</li> <li>• Long-term therapy may result in decreased effectiveness.</li> </ul>		



## Appendix 8-2

## MEDICATIONS USED IN ENDOCRINE DISORDERS—cont'd



Medications	Side Effects	Nursing Implications
<b>SULFONYLUREAS:</b> Stimulate the pancreas to make more insulin.		
Chlorpropamide ( <b>Diabinase</b> ): PO	Hypoglycemia, jaundice, GI disturbance, skin reactions (fewer side effects with 2nd-generation agents).	<ol style="list-style-type: none"> <li>1. Tolbutamide has shortest duration of action; requires multiple daily doses.</li> <li>2. Glyburide has a long duration of action.</li> <li>3. Interact with: calcium channel blockers, oral contraceptives, glucocorticoids, phenothiazines, and thiazide diuretics.</li> </ol>
Glipizide ( <b>Glucotrol</b> ): PO		
Glyburide ( <b>Micronase, DiaBeta</b> ): PO		
Glimepiride ( <b>Amaryl</b> ): PO		
Gliclazide ( <b>Diamicron</b> ): PO		
Tolbutamide ( <b>Orinase</b> ): PO		
Tolazamide ( <b>Tolinase</b> ): PO		
<b>BIGUANIDE:</b> Decrease sugar production in the liver and help the muscles use insulin to break down sugar.		
Metformin ( <b>Glucophage</b> ): PO	Dizziness, nausea, back pain, possible metallic taste.	<ol style="list-style-type: none"> <li>1. Administered with meals.</li> <li>2. Has a beneficial effect on lowering lipids.</li> <li>3. Weight gain may occur.</li> </ol>
<b>ALPHA-GLUCOSIDASE INHIBITOR:</b> Slows down how the body absorbs sugar after eating; also known as “starch blockers.”		
Acarbose ( <b>Precose</b> ): PO	Diarrhea, flatulence, abdominal pain.	<ol style="list-style-type: none"> <li>1. Take at beginning of meals; not effective on an empty stomach.</li> <li>2. Acarbose is contraindicated in clients with inflammatory bowel disease.</li> <li>3. Frequently given with sulfonylureas to increase effectiveness of both medications.</li> </ol>
Miglitol ( <b>Glyset</b> ): PO		
<b>THIAZOLIDINEDIONES:</b> Enhance insulin utilization at receptor sites (they do NOT increase insulin production); also referred to as “insulin sensitizers.”		
Pioglitazone ( <b>Actos</b> ): PO	Weight gain, edema.	<ol style="list-style-type: none"> <li>1. May affect liver function; monitor LFTs.</li> <li>2. Postmenopausal women may resume ovulation; pregnancy may occur.</li> </ol>
Rosiglitazone ( <b>Avandia</b> ): PO		
<b>MEGLITINIDES:</b> (Non-Sulfonylurea Insulin Secretagogues) Stimulate release of insulin from beta cells.		
Nateglinide ( <b>Starlix</b> ): PO	Weight gain, hypoglycemia.	<ol style="list-style-type: none"> <li>1. Rapid onset and short duration.</li> <li>2. Take 30 min before meals (or right at mealtime).</li> <li>3. Do not take if meal is missed.</li> </ol>
Repaglinide ( <b>Prandin</b> ): PO		
<b>DIPEPTIDYL PEPTIDASE-4 (DDP-4) INHIBITORS:</b> Enhances the incretin system, stimulates release of insulin for beta cells, and decreases hepatic glucose production.		
Sitagliptin ( <b>Januvia</b> ): PO	Upper respiratory tract infection, sore throat, headache, diarrhea.	<ol style="list-style-type: none"> <li>1. Should not be used in Type 1 diabetes or for the treatment of diabetic ketoacidosis.</li> </ol>
Vildagliptin ( <b>Galvus</b> ): PO		

## INJECTABLE DRUGS FOR DIABETES

**AMYLIN MIMETICS:** Complements the effects of insulin by delaying gastric emptying and suppressing glucagon secretion.

Pramlintide ( <b>Symlin</b> ): SQ	Hypoglycemia, nausea, injection site reactions.	<ol style="list-style-type: none"> <li>1. Teach client to take other oral medications at least 1 hour prior to taking or 2 hours after, because of delayed gastric emptying.</li> <li>2. Injected into thigh or abdomen.</li> <li>3. Cannot be mixed with insulin.</li> </ol>
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**NURSING PRIORITY:** *Can cause severe hypoglycemia when used with insulin; usually occurs within 3 hours following injection.*

**INCRETIN MIMETICS:** Stimulates release of insulin, decreases glucagon secretion, decreases gastric emptying, and suppresses appetite.

Exenatide ( <b>Byetta</b> ): SQ	Hypoglycemia, nausea, vomiting, diarrhea, headache, possible weight loss.	<ol style="list-style-type: none"> <li>1. Used in conjunction with metformin.</li> <li>2. Monitor weight.</li> <li>3. Not indicated for use with insulin.</li> </ol>
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