

# CHAPTER 15

## ENDOCRINE DISORDERS

### LEARNING OBJECTIVES

- ▶ Recognize common endocrine disorders and analyze processes to make differential diagnoses among them.
  - ▷ Risk factors
  - ▷ Signs and symptoms
  - ▷ Diagnostic tests
  - ▷ Differential diagnoses
- ▶ Describe treatment and management of endocrine disorders.
  - ▷ Management
  - ▷ Prevention

### AGE-RELATED CONCERNS

TABLE 15-1.  
AGE-RELATED CHANGES THAT AFFECT PHARMACOTHERAPY

PHARMACOKINETICS	IMPLICATION
<b>Absorption</b> Increased gastric pH; decreased motility, absorptive surface area, first-pass effect	Slower absorption and delayed onset, greater bioavailability of drugs with high hepatic extraction
<b>Distribution</b> Decreased total body fluid, increased body fat, decreased lean muscle mass and albumin	Small older adults more sensitive to dose, lipophilic drugs have increased half-life, hydrophilic drugs have increased peak concentrations
<b>Metabolism</b> Decreased liver and renal blood flow, glomerular filtration rate (GFR), altered cytochrome P450 metabolism	Increased or decreased effect and toxicity of drugs metabolized
<b>Excretion</b> Decreased liver and renal blood flow and renal tubule secretory function	Increased effect and toxicity of renally eliminated drugs and those metabolized in liver

## HYPOTHERMIA

- ▶ Condition in which the body cannot adequately regulate body temperature because of overwhelming cold conditions in the environment.
- ▶ Hypothermia is diagnosed when core body temperature is  $\leq 95^{\circ}\text{F}$  ( $32^{\circ}\text{C}$ ; Dunphy et al. 2015).
  - ▷ Mild hypothermia
    - ▶ A core temperature of  $89.6^{\circ}\text{F}$ – $95^{\circ}\text{F}$  ( $32^{\circ}\text{C}$ – $35^{\circ}\text{C}$ )
  - ▷ Moderate hypothermia
    - ▶ A core temperature of  $82.4^{\circ}\text{F}$ – $89.6^{\circ}\text{F}$  ( $28^{\circ}\text{C}$ – $32^{\circ}\text{C}$ )
  - ▷ Severe hypothermia
    - ▶ A core temperature of  $<82.4^{\circ}\text{F}$  ( $28^{\circ}\text{C}$ )

## Risk Factors

- ▶ Thyroid disease
- ▶ Cardiovascular disease
- ▶ Exposure to cold
- ▶ Age:  $>75$  years
- ▶ Alcohol use
- ▶ Antidepressants
- ▶ Electrolyte imbalance
- ▶ Inactivity
- ▶ Extended periods in cold environment
- ▶ Homelessness and mental illness

## Signs and Symptoms

- ▶ Shivering
  - ▷ Indicates heat regulation still active
  - ▷ May stop as hypothermia progresses
- ▶ Slow and shallow breathing, weak pulse
- ▶ Altered level of consciousness
- ▶ Confusion, memory loss
- ▶ Drowsiness, exhaustion
- ▶ Slurred or mumbled speech
- ▶ Loss of coordination

## Diagnostic Tests

- ▶ Arterial blood gases
  - ▷ Altered if body temperature is  $<98.6^{\circ}\text{F}$  ( $37^{\circ}\text{C}$ )
  - ▷ May show higher oxygen or carbon dioxide or low pH
- ▶ Electrolytes
  - ▷ Potassium  $> 10$  mmol/L associated with poor prognosis
  - ▷ Serum glucose levels
    - ▶ Hyperglycemia may be seen in acute hypothermia.
    - ▶ Hypoglycemia may be seen in chronic hypothermia.
- ▶ Elevated hematocrit

## Differential Diagnoses

- ▶ Alcohol or drug toxicity
- ▶ Carbon monoxide poisoning
- ▶ Stroke
- ▶ Ventricular fibrillation or tachycardia
- ▶ Therapeutic hypothermia
- ▶ Myocardial infarction,
- ▶ Diabetic hypoglycemia or hyperglycemia
- ▶ Sepsis
- ▶ Hypothyroidism  
(Dunphy et al. 2015)

## Management

- ▶ Remove any wet clothing.
- ▶ Protect from further heat loss with warm, dry clothes and blankets.
- ▶ Warm blankets (electric blanket, hot packs, heating pad) to torso, axilla, neck, groin.
- ▶ Move to a warm, dry area.
- ▶ Warm liquids intravenously and orally, lavage, humidified oxygen.
- ▶ Bretylium (5 mg/kg initially) for ventricular ectopy.
- ▶ Observe for signs of rhabdomyolysis.
- ▶ Warmed IV saline, rewarm body temp  $1\text{--}2^{\circ}\text{C}$  per hour. (Dunphy et al. 2015)

## Prevention

- ▶ Avoid alcohol and caffeine when in cold environments for extended periods.
- ▶ Wear warm clothes in layers.

- ▶ Know the signs of cold weather illnesses and injuries.
- ▶ Take breaks in warm shelters when in cold for extended time.

## HYPERTHERMIA

- ▶ Condition in which the body cannot adequately regulate body temperature because of being overwhelmed by hot conditions in the environment.
- ▶ Hyperthermia is diagnosed when core body temperature is  $\geq 99^{\circ}\text{F}$  ( $37.2^{\circ}\text{C}$ ).

## Risk Factors

- ▶ Thyroid disease
- ▶ Cardiovascular disease
- ▶ Sustained muscle activity
- ▶ Dehydration
- ▶ No air conditioning
- ▶ Lack of mobility
- ▶ Overdressing
- ▶ Overcrowding
- ▶ Chronic medical conditions
- ▶ Environmental exposure to heat
- ▶ Drug toxicity

## Signs and Symptoms

- ▶ Heat exhaustion
  - ▷ Occurs when there is a prolonged period of fluid loss (e.g., from perspiration, diarrhea, or use of diuretics) and exposure to warm ambient temperatures without adequate fluid and electrolyte replacement (Dunphy et al. 2015, 1139)
  - ▷ Normal to slightly elevated core temperature
  - ▷ Mental status intact
  - ▷ Fatigue or malaise
  - ▷ Orthostatic hypotension, tachycardia
  - ▷ Dehydration
  - ▷ Nausea, vomiting, diarrhea
    - ▶ Due to splanchnic vasoconstriction
- ▶ Heatstroke
  - ▷ Occurs when core body temperature reaches  $>105^{\circ}\text{F}$  ( $40.6^{\circ}\text{C}$ ; Dunphy et al. 2015)
  - ▷ Confusion, ataxia, coma, seizures, delirium

- ▷ Hot, dry skin
- ▷ Vague weakness, nausea, vomiting, headache
- ▷ High central venous pressure, low systemic vascular resistance
- ▷ Elevated transaminase
- ▷ Coagulopathy
- ▷ Rhabdomyolysis
- ▷ Renal failure

### Diagnostic Tests

- ▶ Complete blood count (CBC)
- ▶ Thyroid panel

### Differential Diagnoses

- ▶ Thyroid storm
- ▶ Meningitis

### Management

- ▶ Reduce temperature
- ▶ Aggressive temperature reduction if hemodynamically unstable
- ▶ Responsive to cool environment, fluid and electrolyte replacement
- ▶ Heatstroke management
  - ▷ Rapid cooling; if ice packs are used, place them in groin and axillary region.
  - ▷ Monitor rectal temperature.
  - ▷ Supplemental oxygen, including possible intubation, may be necessary.
  - ▷ IV fluids (usually 0.9 percent normal saline; Dunphy et al. 2015, 1139)
- ▶ Neuroleptic malignant syndrome and malignant hyperthermia
  - ▷ Dantrolene 2.5 mg/kg repeated q5min.
  - ▷ Until reaction occurs or total dose of 10–20 mg/kg reached.
  - ▷ Discontinue offending drug.

### Prevention

- ▶ Dress appropriately for weather, dress in layers.
- ▶ Drink extra fluids.
- ▶ Avoid caffeine and alcohol.

- ▶ Stay indoors on hot, humid days.
- ▶ Keep air conditioner on or use a fan to circulate air.
- ▶ If no air conditioning, go to community cooling center.

## DIABETES MELLITUS

- ▶ Twenty-nine million Americans are living with diabetes and 86 million are living with prediabetes, a serious health condition that increases a person's risk of type 2 diabetes and other chronic diseases.
- ▶ Type 2 diabetes accounts for about 90–95 percent of all diagnosed cases of diabetes, and type 1 diabetes accounts for about 5 percent. The health and economic costs for both are enormous:
  - ▷ Diabetes was the seventh leading cause of death in the United States in 2013 (and may be underreported).
  - ▷ Diabetes is the leading cause of kidney failure, lower-limb amputations, and adult-onset blindness.
  - ▷ More than 20 percent of healthcare spending is for people with diagnosed diabetes (Centers for Disease Control and Prevention [CDC] 2016).
  - ▷ Costs for diabetic care exceed \$245 billion annually; one in five healthcare dollars is spent on diabetes each year.

### Types

- ▶ Type 1 diabetes, caused by beta-cell destruction, usually leading to absolute insulin deficiency
- ▶ Type 2 diabetes, caused by progressive loss of insulin secretion on the background of insulin resistance
- ▶ Gestational diabetes mellitus (GDM), diagnosed in the second or third trimester of pregnancy and not clearly overt diabetes
- ▶ Specific types of diabetes attributable to other causes (American Diabetes Association [ADA] 2015)

### Complications

- ▶ Retinopathy, blindness, cataracts, glaucoma
- ▶ Nephropathy, renal failure
- ▶ Cardiovascular disease, atherosclerosis, myocardial infarction (MI)
- ▶ Cerebrovascular disease, stroke
- ▶ Peripheral neuropathy
- ▶ Infection
- ▶ Foot ulcers, bacterial and fungal skin infections

- ▶ Hyperosmolar nonketotic coma
- ▶ Diabetic ketoacidosis (DKA)

## Screening

- ▶ Screening for prediabetes and risk for future diabetes with an informal assessment of risk factors or validated tools should be considered in asymptomatic adults.
- ▶ For all people, testing should begin at age 45 years.
- ▶ Testing for prediabetes and risk for future diabetes in asymptomatic people should be considered in adults of any age who are overweight or obese (body mass index [BMI]  $>25 \text{ kg/m}^2$  or  $>23 \text{ kg/m}^2$  in Asian Americans) and who have one or more additional risk factors for diabetes:
  - ▷ A1C  $> 5.7$  percent (39 mmol/mol), IGT, or IFG on previous testing
  - ▷ First-degree relative with diabetes
  - ▷ High-risk race/ethnicity (e.g., African American, Latino, Native American, Asian American, Pacific Islander)
  - ▷ Women who were diagnosed with GDM
  - ▷ History of cardiovascular disease (CVD)
  - ▷ Hypertension (HTN;  $>140/90$  mmHg or on therapy for HTN)
  - ▷ HDL cholesterol level  $< 35 \text{ mg/dL}$  (0.90 mmol/L) and/or a triglyceride level  $250 \text{ mg/dL}$  (2.82 mmol/L)
  - ▷ Women with polycystic ovary syndrome
  - ▷ Physical inactivity
  - ▷ Other clinical conditions associated with insulin resistance (e.g., severe obesity, acanthosis nigricans)
- ▶ If tests are normal, repeat testing carried out at a minimum of 3-year intervals is reasonable (ADA 2017).

## TYPE 1 DIABETES MELLITUS (FORMERLY CALLED INSULIN-DEPENDENT DIABETES OR IDDM)

- ▶ Beta-cell destructive autoimmune disease that develops in response to an environmental trigger. It is a syndrome produced by disorders in metabolism of carbohydrates, proteins, and fats caused by an absolute absence of insulin that then results in hyperglycemia. Without insulin, ketoacidosis rapidly develops.

## Risk Factors

- ▶ Exposure to viruses, toxic chemicals, or cytotoxins
- ▶ Genetic predisposition

- ▶ First-degree relative with type 1 diabetes
- ▶ Autoimmune disorders

## Signs and Symptoms

- ▶ Acute onset
- ▶ Polyuria, polydipsia
- ▶ Polyphagia, weight loss
- ▶ Blurred vision
- ▶ Fatigue
- ▶ Abdominal pain, nausea and vomiting
- ▶ Vaginal itching and infections
- ▶ Unhealed wounds, skin infections, rashes
- ▶ Dehydration
- ▶ Hypoglycemia or ketotic episodes
- ▶ See table 15–2

**TABLE 15–2.**  
**COMMON FINDINGS IN DIABETES MELLITUS**

BODY SYSTEM	EXAM FINDINGS
Skin	Cellulitis; lower leg ulcers; candidiasis
Eyes	Ptosis; glaucoma; abnormal retinal exam
Mouth	Oral <i>Candida</i> infections
Heart	Resting tachycardia; silent MI
Abdomen	Gastroparesis; residual urine
Peripheral vasculature	Decreased circulation; edema
Central nervous system	Decreased proprioception, vibration, and light touch; ataxia

## Diagnostic Tests

- ▶ Fasting plasma glucose (FPG) *or*
- ▶ Oral glucose tolerance test (OGTT): Plasma glucose value 2 hours after a 75-gram oral glucose challenge *or*
- ▶ Glycosylated hemoglobin (A1C)
- ▶ Diagnostic criteria for diabetes:
  - ▷ A1C > 6.5 percent *or*
  - ▷ FPG > 126 mg/dL *or*
  - ▷ OGTT plasma glucose > 200 mg/dL 2 hours after 75-gram anhydrous glucose load following an 8-hour fast *or*



- ▷ Random plasma glucose > 200 mg/dL with classic symptoms of hyperglycemia or hyperglycemic crisis
- ▶ Diagnostic criteria for prediabetes:
  - ▷ A1C 5.7–6.4 percent *or*
  - ▷ FPG 100 mg/dL to 125 mg/dL *or*
  - ▷ OGTT plasma glucose 140–199 mg/dL 2 hours after 75-gram anhydrous glucose load following an 8-hour fast
- ▶ Decreased C-reactive protein (CRP)
- ▶ Glucose and ketones in urine
- ▶ Blood urea nitrogen (BUN), creatinine elevated if patient dehydrated
- ▶ Urinalysis, urine microalbumin
- ▶ Fasting lipids
  - ▷ Triglycerides > 150 mg/dL
- ▶ Thyroid-stimulating hormone level

### Differential Diagnoses

- ▶ Type 2 diabetes, diabetes insipidus
- ▶ Pancreatic disease
- ▶ Pheochromocytoma
- ▶ Cushing's syndrome or acromegaly
- ▶ Liver disease
- ▶ Salicylate poisoning
- ▶ Renal disease with glucosuria
- ▶ Secondary effects of oral contraceptives, corticosteroids, thiazides, phenytoin, nicotinic acid

### Management

- ▶ Replace lost endogenous insulin.
- ▶ Most people with type 1 diabetes should be treated with multiple-dose insulin injections (three to four injections per day of basal and prandial insulin) or continuous subcutaneous insulin infusion (see table 15–3).
- ▶ Match prandial insulin to carbohydrate intake, premeal blood glucose, and anticipated physical activity.
- ▶ For most patients (especially those at elevated risk of hypoglycemia), use insulin analogs.
- ▶ For patients with frequent nocturnal hypoglycemia, recurrent severe hypoglycemia, or hypoglycemia unawareness, a sensor-augmented low glucose threshold suspend pump may be considered (ADA 2016a).

- ▶ A1C goals
  - ▷ A reasonable A1C goal for many nonpregnant adults is <7 percent (53mmol/mol).
  - ▷ More stringent A1C goals (such as <6.5 percent [48 mmol/mol]) for selected individual patient if this can be achieved without significant hypoglycemia or other adverse effects of treatment (e.g., polypharmacy). Appropriate patients might include those with short duration of diabetes, type 2 diabetes treated with lifestyle or metformin only, long life expectancy, or no significant cardiovascular disease.
  - ▷ Less stringent A1C goals (such as <8 percent [64 mmol/mol]) may be appropriate for patients with a history of severe hypoglycemia, limited life expectancy, advanced microvascular or macrovascular complications, extensive comorbid conditions, or long-standing diabetes for whom the goal is difficult to achieve despite diabetes self-management education, appropriate glucose monitoring, and effective doses of multiple glucose-lowering agents including insulin (ADA 2017).
  - ▷ Treat HTN, proteinuria, nephropathy, dyslipidemia with angiotensin-converting enzyme inhibitors (ACEI) unless contraindicated (renal protective).
- ▶ Goal blood pressure (BP) < 140 mm Hg
  - ▷ BP < 130 mm Hg may be appropriate for some patients with diabetes, such as younger patients, those with albuminuria, and those with HTN and one or more additional atherosclerotic cardiovascular disease risk factors (ADA 2016b).
  - ▷ Aspirin 81–325 mg daily (unless contraindicated)
  - ▷ Reduces risk of diabetic atherosclerosis
  - ▷ Treat dyslipidemia

## Prevention

- ▶ None known

## TYPE 2 DIABETES MELLITUS (FORMERLY CALLED NON-INSULIN-DEPENDENT DIABETES)

- ▶ Elevated blood glucose levels caused by reduced pancreatic production of insulin and inability to use insulin efficiently, including insulin resistance

## Risk Factors

- ▶ Obesity, inactivity
- ▶ More than 20 percent over ideal body weight or BMI (BMI > 25 kg/m<sup>2</sup> or > 23 kg/m<sup>2</sup> in Asian Americans)
- ▶ High refined carbohydrate, high-fat, low-fiber diet
- ▶ Family history

**TABLE 15-3.**  
**INSULIN PRODUCTS**

PREPARATION	BRANDS	ONSET	PEAK	DURATION	ROUTE
Rapid-Acting Insulin analogs	NovoLog Humalog	15 min	60 min	3 hr	SC before meals
Rapid-Acting	AFREZZA (insulin human)	12–15 min	60 min	2.5–3 hr	Inhalation; administer at the beginning of a meal
Rapid-Acting	APIDRA (insulin glulisine [rDNA origin] injection)	15 min	60 min	2–4 hr	SC 15 minutes before or within 20 minutes after starting a meal
Short-Acting Regular	Novolin R Humulin R	30 min	2–4 hr	6–8 hr	SC, IM, IV before meals
Intermediate- Acting NPH	Novolin N Humulin N	1–2 hr	6–12 hr	18–24 hr	SC b.i.d.
Long-Acting Ultralente	Humulin L	1–3 hr	6–12 hr	18–24 hr	SC q12h
Long-Acting Insulin glargine	Lantus	1 hr	None	24 hr	SC at h.s.
Long-Acting Insulin detemir	Levemir Levemir FlexPen	1–3 hr	8–10 hr	18–26 hr	
Long-Acting Insulin glargine	Toujeo	1–1½ hr	No peak	20–24 hr	SC once a day
Ultra Long-Acting Insulin	Degludec Tresiba	30–90 min	No peak	42 hr	SC once daily at any time of day

Note: SC = subcutaneous; IV = intravenous; IM = intramuscular

- ▶ People of African American, Asian American, Hispanic, Native American, Pacific Island descent at higher risk
- ▶ Advanced age; as age increases, the risk of diabetes increases.
  - ▷ Generally, type 2 diabetes occurs in middle-aged adults, most frequently after age 45 (American Heart Association [AHA] 2017)
- ▶ Previous impaired glucose tolerance
- ▶ Metabolic syndrome
- ▶ Lipid abnormalities
  - ▷ High-density lipoprotein (HDL) < 35 mg/dL or triglycerides > 250 mg/dL

## Signs and Symptoms

- ▶ Polyuria and polydipsia
- ▶ Increased appetite
- ▶ Extreme fatigue, blurred vision
- ▶ Slow wound healing
- ▶ Tingling, pain, numbness in hands or feet

## Diagnostic Tests

- ▶ Urinalysis
  - ▷ For protein, glucose, ketones, and microalbuminuria
- ▶ BUN and creatinine
  - ▷ Serum and urine
- ▶ Serum cholesterol, lipid profile
- ▶ A1C
- ▶ Fasting blood glucose (FBG)

## Differential Diagnoses

- ▶ Type 1 diabetes
- ▶ Diabetes insipidus

## Management

- ▶ If FBG < 250 mg/dL:
  - ▷ Nutrition counseling and exercise for 3 months
  - ▷ Lifestyle modifications
  - ▷ Dietary changes
  - ▷ Weight reduction
  - ▷ Daily exercise
  - ▷ Glycemic control
- ▶ A1C goals:
  - ▷ A reasonable A1C goal for many nonpregnant adults is <7 percent (53mmol/mol).
  - ▷ More stringent A1C goals (such as <6.5 percent [48 mmol/mol]) for selected individual patient if this can be achieved without significant hypoglycemia or other adverse effects of treatment (e.g., polypharmacy). Appropriate patients might include those with short duration of diabetes, type 2 diabetes treated with lifestyle or metformin only, long life expectancy, or no significant cardiovascular disease.

- ▷ Less stringent A1C goals (such as <8 percent [64 mmol/mol]) may be appropriate for patients with a history of severe hypoglycemia, limited life expectancy, advanced microvascular or macrovascular complications, extensive comorbid conditions, or long-standing diabetes for whom the goal is difficult to achieve despite diabetes self-management education, appropriate glucose monitoring, and effective doses of multiple glucose-lowering agents including insulin (ADA 2017).
- ▶ Pharmacologic treatment (see table 15–4)
  - ▷ Metformin, if not contraindicated and if tolerated, is the preferred initial pharmacologic agent for the treatment of type 2 diabetes.
    - ▶ Metformin monotherapy should be started at diagnosis of type 2 diabetes.

**TABLE 15–4.**  
**ORAL AND NONINSULIN INJECTABLE HYPOGLYCEMIC AGENTS**

GENERIC AND CLASS	BRAND NAME
<b>Second-Generation Sulfonylureas</b>	
Glipizide	Glucotrol, Glucotrol XL
Glyburide	DiaBeta, Micronase
Glyburide, micronized	Glynase, Press Tab
<b>Meglitinides</b>	
Repaglinide	Prandin
Nateglinide	Starlix
<b>Biguanides</b>	
Metformin	Glucophage XR (Calculate creatinine clearance. Do not give to older patients if clearance is <50 cc/min. Use in ages >80 years is not FDA-approved.)
<b>Thiazolidinediones</b>	
Pioglitazone	Actos
Rosiglitazone	Avandia
<b>Alpha-Glucosidase Inhibitors</b>	
Acarbose	Precose
Miglitol	Glyset
<b>Incretin Mimetics</b>	
<b>GLP-1 Agonists</b>	
Exenatide	Byetta
Liraglutide	Victoza
Albiglutide	Tanzeum
Dulaglutide	Trulicity
<b>Amylin Analog</b>	
Pramlintide	Symlin
<b>DPP-4 Inhibitors</b>	
Sitagliptin	Januvia
Saxagliptin	Onglyza
Linagliptin	Tradjenta

- ▷ When A1C is  $>9$  (75 mmol/mol), consider initiating dual combination therapy.
- ▷ Consider initiating insulin therapy (with or without additional agents) in patients with newly diagnosed type 2 diabetes who are symptomatic and/or have A1C  $\geq 10$  percent (86mmol/mol) and/or blood glucose levels  $>300$  mg/dL (16.7 mmol/L).
- ▷ If noninsulin monotherapy at maximum tolerated dose does not achieve or maintain the A1C target after 3 months, add a second oral agent, a glucagon-like peptide-1 receptor agonist, or basal insulin.
- ▷ Lifestyle therapy plus antihyperglycemic therapy is recommended.
  - ▶ Treat HTN, proteinuria, nephropathy, dyslipidemia with ACEIs unless contraindicated (renal protective).
- ▶ Goal: BP  $< 140$  mm Hg
- ▶ BP  $< 130$  mm Hg may be appropriate for some patients with diabetes, such as younger patients, those with albuminuria, and those with HTN and one or more additional atherosclerotic cardiovascular disease risk factors (ADA 2016b)
  - ▷ Aspirin 81–325 mg daily (unless contraindicated).
- ▶ Reduces risk of diabetic atherosclerosis
  - ▷ Treat dyslipidemia.

## Prevention

- ▶ Maintain optimal weight.
- ▶ Exercise.
- ▶ Healthy balanced diet, avoiding simple carbohydrates.

## HYPOTHYROIDISM

- ▶ Endocrine disorder caused by inadequate thyroid hormone secretion; constitutes 90 percent of cases of primary hypothyroidism (gland cannot produce hormone).
- ▶ Hashimoto's thyroiditis is an autoimmune disorder resulting in hypothyroidism and is the most common cause of hypothyroid after age 8.

## Risk Factors

- ▶ Hypothyroidism two to three times more common in women (Dunphy et al. 2015, 856)
- ▶ Presence of thyroid antibodies
- ▶ Treatment of hyperthyroidism
- ▶ Family history of thyroid or autoimmune disease
- ▶ Pituitary or hypothalamus disease
- ▶ Type 1 diabetes

- ▶ Postpartum
  - ▷ Maternal thyroid-stimulating hormone-binding antibodies
- ▶ Surgery
- ▶ Previous radiation to head or neck area
- ▶ Iodine deficiency or excess
- ▶ Medications
  - ▷ Lithium, sulfonamides, phenylbutazone, amiodarone, prolonged treatment with iodides

## Signs and Symptoms

- ▶ Affects all systems (see table 5–5).
- ▶ Thyroid gland may or may not be palpable.
  - ▷ If palpable, may be enlarged or atrophied, tender, nodules
- ▶ Fatigue, lethargy.
- ▶ Muscle weakness, stiffness.
- ▶ Memory loss, depression.
- ▶ Slowed speech, hoarseness.
- ▶ Periorbital edema.
- ▶ Dry skin, coarse hair, hair loss.
- ▶ Temporal thinning of brows, brittle nails.
- ▶ Weight gain.
- ▶ Constipation.
- ▶ Cold intolerance.

**TABLE 15–5.**  
**HYPOTHYROID PHYSICAL CHANGES**

SYSTEM AFFECTED	SIGNS
Face	Facial periorbital edema, swollen tongue, outer eyebrow loss
Skin	Dryness, coarse hair, nail loss
Ears	Decreased acuity
Thyroid	Goiter or atrophy, tender, nodules
Respiratory	Dyspnea, pleural effusion
Cardiac	Bradycardia, low-voltage electrocardiogram (ECG)
Abdominal	Hypoactive bowel sounds, ascites
Extremities	Edema in hands, legs, feet; weight gain
Neurological	Dementia, paranoia, slow or delayed reflexes, cerebellar ataxia, carpal tunnel syndrome

## Diagnostic Tests

- ▶ Thyroid-stimulating hormone (TSH) assay
  - ▷ Elevated
  - ▷ Low if due to pituitary insufficiency
- ▶ Free T4
  - ▷ Elevated TSH or low free T4
    - ▶ Confirms hypothyroidism
  - ▷ Subclinical hypothyroidism
    - ▶ Elevated TSH with normal free T4
  - ▷ Pituitary or hypothalamic failure
    - ▶ TSH normal or low or mildly elevated free T4
  - ▷ If secondary hypothyroid suspected
    - ▶ Serum prolactin, neuroradiological studies, pituitary and adrenal, pituitary gonadal function studies
  - ▷ CBC, electrolytes, BUN, creatinine, glucose, calcium, phosphates, albumin, pregnancy test, urine protein, lipids as indicated

## Differential Diagnoses

- ▶ Depression, dementia
- ▶ Obesity
- ▶ Ischemic heart disease, chronic heart failure
- ▶ Kidney failure, nephrotic syndrome
- ▶ Cirrhosis
- ▶ Congenital or transient hypothyroidism
- ▶ Thyroid hormone resistance
- ▶ Hypopituitarism

## Management

- ▶ Thyroid hormone replacement.
  - ▷ Lifelong thyroid hormone replacement is necessary.
- ▶ First-line therapy for primary hypothyroidism.
  - ▷ Levothyroxine (T4) 25–50 mcg p.o. daily in healthy persons
  - ▷ Start at the lowest dose in frail older adults.
  - ▷ Overreplacement can trigger cardiovascular problems, and atrial fibrillation.
- ▶ Repeat TSH in 6–8 weeks after initiating therapy.



- ▶ Increase every 6–8 weeks until TSH is in normal limits, then repeat TSH every 6 months when regulated.
- ▶ Monitor for signs and symptoms of hyperthyroidism.
- ▶ Improvement seen within 1 month of starting medication.
- ▶ Symptom resolution within 3–6 months.
- ▶ Check lipids annually.

## Prevention

- ▶ Monitor thyroid levels closely when taking replacement or medications known to decrease thyroid hormones.

## HYPERTHYROIDISM AND THYROTOXICOSIS

- ▶ Endocrine disorder caused by overproduction of thyroid hormone T4 (thyroxine) and T3 (triiodothyronine)

## Risk Factors

- ▶ Family history of thyroid and autoimmune disorders
- ▶ Thyroid replacement hormone
- ▶ Graves's disease
- ▶ Multinodular goiter or solitary nodule
- ▶ Transient thyroiditis
- ▶ Drug-induced
  - ▷ Iodide-containing drugs
    - ▶ Amiodarone, contrast media

## Signs and Symptoms

- ▶ Weight loss, increased appetite
- ▶ Insomnia, nightmares
- ▶ Palpitations
- ▶ Fatigue, weakness
- ▶ Sensitivity to heat
- ▶ Irritability, anxiety
- ▶ Severe depression in older adults
- ▶ Increased frequency of bowel movements
- ▶ Diarrhea, pernicious vomiting
- ▶ See table 15–6 for physical changes

**TABLE 15–6.**  
**HYPERTHYROID PHYSICAL CHANGES**

SYSTEM	SIGNS
Adrenergic	Tachycardia, sweating, palpitations, tremor, lid lag
Skin	Warm, moist, diaphoresis, thin or fine hair, spider angiomas
Eyes (Graves's disease only)	Periorbital edema, exophthalmos, blurred vision, photophobia, diplopia
Cardiac	Atrial fibrillation, angina, congestive heart failure, systolic flow murmurs, widened pulse pressure

### Diagnostic Tests

- ▶ TSH, free T4
  - ▷ TSH low or undetectable; T4 elevated
  - ▷ If free T4 normal, order T3
    - ▶ T3 elevated
- ▶ Other labs
  - ▷ Hypercalcemia, elevated alkaline phosphatase, low hemoglobin or hematocrit
  - ▷ Perform urine pregnancy test if abnormal menses
- ▶ Thyroid autoantibodies
  - ▷ Elevated serum antinuclear antibody
  - ▷ Elevated TSH receptor antibody
- ▶ Radioactive uptake
  - ▷ Normal values:
    - ▶ In 6 hours: 3–16 percent
    - ▶ In 24 hours: 8–25 percent
      - ▷ High radioactive iodine uptake
    - ▶ Graves's disease, goiter
      - ▷ Low radioactive iodine uptake
    - ▶ Thyroiditis
- ▶ Thyroid uptake scan or ultrasound for palpable nodules to rule out cold nodule
- ▶ Thyroid biopsy
- ▶ CT scan for eye findings to rule out tumor
- ▶ ECG in older adults

### Differential Diagnoses

- ▶ Thyrotoxic phase of Hashimoto's thyroiditis
- ▶ Psychological disorders

- ▷ Anxiety, panic, psychosis
- ▶ Infection
- ▶ Hormone ingestion
- ▶ Plummer's disease
- ▶ Toxic multinodular goiter
- ▶ Acromegaly
- ▶ Malignancy
- ▶ Congestive heart failure (CHF), new onset or worsening angina
- ▶ Orbital tumors
- ▶ Myasthenia gravis

## Management

- ▶ Radioactive iodine
  - ▷ Treatment of choice for Graves's disease, symptomatic multinodular goiter, single hyperfunctioning adenoma, and older adults
  - ▷ 1–2 doses orally
    - ▶ Euthyroid in 2–6 months.
    - ▶ Hypothyroidism may result.
- ▶ Antithyroid medications
  - ▷ Propylthiouracil (PTU) 100–150 mg p.o. q8h initially
    - ▶ 50–100 mg b.i.d. maintenance
  - ▷ Methimazole (Tapazole) 20–30 mg p.o. q12 h initially
    - ▶ 5–10 mg daily maintenance
    - ▶ Euthroid in 4–6 weeks
  - ▷ Usually on medication for 1–2 years, then gradually weaned
- ▶ Symptom management
  - ▷ Beta blocker
    - ▶ For catecholamine symptoms
    - ▶ Propranolol 10–60 mg p.o. q6h for catecholamine symptoms
    - ▶ Atenolol 50–100 mg p.o. daily
  - ▷ Multivitamin
  - ▷ Calcium with vitamin D, bisphosphonate
    - ▶ Replenish bone
  - ▷ Diltiazem
    - ▶ If unable to take beta blockers

- ▷ Check bone density (dual-energy X-ray absorption [DXA]); if indicated, give bisphosphonate
- ▷ Eye lubricants for ophthalmopathy

## Prevention

- ▶ Monitor thyroid levels closely when taking replacement or medications known to increase thyroid hormones.

## THYROID NODULE AND THYROID CANCER

- ▶ Abnormal growth in thyroid gland.
- ▶ May function independent of hypothalamic and pituitary feedback.
- ▶ More than one nodule is called multinodular goiter.
- ▶ A fluid- or blood-filled nodule is a thyroid cyst.
- ▶ A nodule that produces thyroid hormone is autonomous.
  - ▷ Autonomous nodules (hot nodule on thyroid scan) are usually benign and may cause symptoms of hyperthyroidism.
- ▶ A nonfunctioning nodule (cold nodule on thyroid scan) may be malignant.
  - ▷ Most thyroid cancers are found between ages 20 and 50.
  - ▷ A solitary nodule is more likely to be cancerous than multiple nodules.
  - ▷ The majority of nodules are benign.
  - ▷ 90 percent of women older than age 60 years have a nodular thyroid gland.
  - ▷ 60 percent of men older than age 80 years have a nodular thyroid gland.

## Risk Factors for Thyroid Nodule

- ▶ Iodine deficiency
- ▶ Female
- ▶ Increasing age
- ▶ Residing in area of endemic iodine deficiency

## Risk Factors for Thyroid Cancer

- ▶ Family history of thyroid cancer or multiple endocrine metaplastic type II carcinoma
- ▶ Male
- ▶ Age < 15 years or > 70 years
- ▶ Head, neck, chest radiation exposure
- ▶ Single nodule

## Signs and Symptoms

- ▶ History of hypothyroidism or hyperthyroidism
  - ▷ Hyperthyroid symptoms if nodule is producing thyroid hormone
- ▶ Hoarseness, cough, dysphagia, obstruction, shortness of breath
  - ▷ Hoarseness may be caused by nodule location and causing pressure
- ▶ Ear, jaw, throat pain; neck tenderness, swelling, or enlargement
- ▶ Malignant
  - ▷ Hoarseness, enlarged cervical nodes
  - ▷ Dyspnea; palpable fixed, painless, hard, irregular mass (tumor)
- ▶ Benign
  - ▷ Multiple nodules palpable
    - ▶ Nodular Hashimoto's thyroiditis or multinodular goiter

## Diagnostic Tests

- ▶ Fine-needle biopsy aspiration
  - ▷ If palpable nodules > 1.5 cm
- ▶ Thyroid-stimulating hormone
  - ▷ If low, do free T4
- ▶ Radionuclide scans to determine cytologic results
  - ▷ Hot
    - ▶ 98 percent benign
  - ▷ Cold
    - ▶ 5–10 percent malignant
- ▶ Ultrasound
  - ▷ Determines if cystic
- ▶ Antithyroperoxidase and antithyroglobulin antibodies
  - ▷ Rule out thyroiditis
- ▶ Serum calcitonin for family history of medullary thyroid carcinoma

## Differential Diagnoses

- ▶ Malignant versus benign nodules
- ▶ Cysts
- ▶ Thyroiditis

## Management

- ▶ Refer all persons with thyroid nodules for biopsy (Dunphy et al. 2015).
- ▶ Adequate iodine intake.
- ▶ Surgical resection for malignant or disfiguring tumors.
- ▶ Monitor benign nodules.
- ▶ Suppressive thyroid hormone to shrink nodule.
- ▶ Education
- ▶ Follow up for changes.
  - ▷ Lymphadenopathy, dysphagia, hoarseness, new or worsening symptoms of hypothyroidism or hyperthyroidism

## Prevention

- ▶ None known

## REFERENCES

- American Diabetes Association. 2002. "Diabetes Mellitus and Exercise." *Diabetes Care* 25 (S1): S64–S68. [http://care.diabetesjournals.org/content/25/suppl\\_1/s64.full](http://care.diabetesjournals.org/content/25/suppl_1/s64.full).
- . 2012. "Clinical Practice Recommendations," supplement, *Diabetes Care* 35 (S1).
- . 2015. "Standards of Medical Care in Diabetes—2015," supplement, *Diabetes Care* 38 (S1). <http://dx.doi.org/10.2337/dc15-s001>.
- . 2016a. "Approaches to Glycemic Treatment." In "Standards of Medical Care in Diabetes—2016," supplement, *Diabetes Care* 39 (S1): S52–S59. <http://dx.doi.org/10.2337/dc16-s010>.
- . 2016b. "Cardiovascular Disease and Risk Management." In "Standards of Medical Care in Diabetes—2016," supplement, *Diabetes Care* 39 (S1): S60–S71. <http://dx.doi.org/10.2337/dc16-s011>.
- . 2016c. "Classification and Diagnosis of Diabetes." In "Standards of Medical Care in Diabetes—2016," supplement, *Diabetes Care* 39 (S1): S13–S22. <http://dx.doi.org/10.2337/dc16-s005>.
- . 2016d. "Glycemic Targets." In "Standards of Medical Care in Diabetes—2016," supplement, *Diabetes Care* 39 (S1): S39–S46. <http://dx.doi.org/10.2337/dc16-s008>.
- . 2017. "Classification and Diagnosis of Diabetes." *Diabetes Care* 40 (S1): S11–S24. <http://dx.doi.org/10.2337/dc17-s005>.
- American Heart Association. 2017. "Understand Your Risk for Diabetes." [http://www.heart.org/HEARTORG/Conditions/More/Diabetes/UnderstandYourRiskforDiabetes/Understand-Your-Risk-for-Diabetes\\_UCM\\_002034\\_Article.jsp](http://www.heart.org/HEARTORG/Conditions/More/Diabetes/UnderstandYourRiskforDiabetes/Understand-Your-Risk-for-Diabetes_UCM_002034_Article.jsp).
- Centers for Disease Control and Prevention. 2013. "Surveillance Reports." Diabetes Reports and Publications. <https://www.cdc.gov/diabetes/library/reports/surveillance.html>.

———. 2016. "Diabetes." *Chronic Disease Prevention and Health Promotion*. <http://www.cdc.gov/chronicdisease/resources/publications/aag/diabetes.htm>.

Dunphy, L., J. Winland-Brown, B. Porter, and D. Thomas, eds. 2015. *Primary Care: The Art and Science of Advanced Practice Nursing*. 4th ed. Philadelphia: F. A. Davis.

