A 61-year-old woman presents to her primary care clinic with polyuria, polydipsia, and lightheadedness and is subsequently admitted to the hospital for symptomatic hyperglycemia. Type 2 diabetes mellitus was recently diagnosed and metformin was initiated. However, after 5 months, her regimen was transitioned to NPH insulin and regular insulin due to poor glycemic control. The current total daily insulin dose is 170 units. Her history is notable for a 55.5-lb (27-kg) weight loss since the diagnosis of diabetes.

On physical examination, she has temporal wasting and extensive acanthosis nigricans, including on the palms and tongue. Her height is 64 in (162.5 cm), and weight is 116 lb (52.7 kg) (BMI = 19.9 kg/m2).

Laboratory test results:

Anion gap, normal
Triglycerides = 39 mg/dL (<150 mg/dL [optimal]) (SI: 0.44 mmol/L [<1.70 mmol/L])
Her hospital course is characterized by the persistence of hyperglycemia without ketosis or fasting hypoglycemia. Intravenous insulin is initiated, peaking at 11,650 units daily.
Which of the following is the underlying cause of this patient’s presentation?

A. Antiinsulin antibodies  
B. Antiinsulin receptor antibodies  
C. Occult infection  
D. Cushing syndrome  
E. Occult malignancy

Correct Answer: B

Learning objective:
Identify severe insulin resistance and the clinical and laboratory findings that suggest type B insulin resistance as a cause.
ITE 2019 Question 2

A 78-year-old homeless woman is admitted to the hospital with diffuse bony pain and a pathologic, atraumatic fracture of her left humerus. Radiographs reveal widespread lytic and mixed (lytic/sclerotic) lesions throughout the appendicular and axial skeleton. On physical examination, a large breast mass is palpated, and needle biopsy confirms adenocarcinoma of the breast.

Laboratory test results:

- Serum calcium = 12.3 mg/dL (SI: 3.08 mmol/L [2.1-2.6 mmol/L])
- Albumin = 2.8 g/dL (3.5-5.0 μg/dL) (SI: 28 μg/L [35-50 μg/L])
- Creatinine = 6.2 mg/dL (0.6-1.1 mg/dL) (SI: 548 μmol/L [53.0-97.2 μmol/L])
- Intact PTH = <10 pg/mL (10-65 pg/mL) (SI: <10 ng/L [10-65 ng/L])
- Alkaline phosphatase = 320 U/L (50-120 U/L) (SI: 5.3 µkat/L [0.84-2.00 µkat/L])

After 24 hours of vigorous intravenous saline hydration, the following laboratory results are documented:

- Serum calcium = 11.0 mg/dL (SI: 2.75 mmol/L)
- Creatinine = 4.2 mg/dL (SI: 371.3 μmol/L)

The oncology team decides to treat her with a subcutaneous injection of denosumab, 120 mg.
In this patient, which of the following is the most likely adverse effect of this therapy?

A. Worsening renal function
B. Osteonecrosis of the jaw
C. A severe flulike syndrome
D. Impaired fracture healing
E. Severe hypocalcemia

Correct Answer: E

Learning objective:
Anticipate the risk of symptomatic hypocalcemia following denosumab therapy in the setting of renal failure.
ITE 2019 Question 3

A 54-year-old man has had difficult-to-control hypertension for 3 years. He has gained 33 lb (15 kg) in the last 3 years and diabetes mellitus was diagnosed 1 year ago. His medications include metformin, amlodipine, valsartan, and hydrochlorothiazide.

On physical examination, his BMI is 35 kg/m² and blood pressure is 148/92 mm Hg. He has scattered 1- to 2-cm bruises on his extremities. He has no dorsocervical fat pad, striae, or proximal muscle strength weakness.

Laboratory test results:

- Sodium = 139 mEq/L (136-142 mEq/L) (SI: 139 mmol/L [136-142 mmol/L])
- Potassium = 3.5 mEq/L (3.5-5.0 mEq/L) (SI: 3.5 mmol/L [3.5-5.0 mmol/L])
- Serum aldosterone = 14 ng/dL (4-21 ng/dL) (SI: 388.4 pmol/L [111.0-582.5 pmol/L])
- Plasma renin activity = <0.6 ng/mL per h (0.6-4.3 ng/mL per h)
- Fasting glucose = 165 mg/dL (70-99 mg/dL) (SI: 9.2 mmol/L [3.9-5.5 mmol/L])
Abdominal CT with contrast demonstrates a 3.8-cm left adrenal mass and an atrophic right adrenal gland (see image, arrows).
Which of the following is the best next step in this patient’s management?

A. Prescribe spironolactone, 50 mg daily
B. Measure plasma metanephrines and perform a 1-mg overnight dexamethasone suppression test
C. Schedule adrenal venous sampling to measure aldosterone and cortisol
D. Perform left adrenalectomy
E. Measure serum aldosterone after administration of 2 L normal saline

Correct Answer: B

Learning objective:
Exclude hypercortisolism and pheochromocytoma when evaluating a large adrenal tumor suspected of causing primary aldosteronism.
ITE 2019 Question 4

A 24-year-old woman with an 8-year history of type 1 diabetes mellitus is evaluated in the emergency department for management of hyperglycemia. Her most recent hemoglobin A1c value was 6.8% (51 mmol/mol) 8 weeks ago. The night before admission, her insulin pump malfunctioned and despite increased fluid intake and several subcutaneous insulin injections, she developed nausea, vomiting, and abdominal pain. Urine ketones were strongly positive.

On physical examination, she is awake and able to answer questions, but she appears fatigued and pauses between sentences. She is afebrile, blood pressure is 96/68 mm Hg, pulse rate is 112 beats/min, and respiratory rate is 24 breaths/min. Her height is 64 in (162.5 cm), and weight is 121 lb (55 kg) (BMI = 20.8 kg/m2). Oral examination reveals dry mucous membranes. She is tachypneic, and Kussmaul respiration is noted. There is diffuse abdominal tenderness but no rebound, guarding, or focal pain. The rest of her physical examination findings are normal.
Initial laboratory test results reveal:

- **pH = 7.0 (7.35-7.45)**
- **Anion gap = 17**
- **Blood glucose = 268 mg/dL (70-99 mg/dL) (SI: 14.9 mmol/L [3.9-5.5 mmol/L])**
- **Serum urea nitrogen = 56 mg/dL (8-23 mg/dL) (SI: 20.0 mmol/L [2.9-8.2 mmol/L])**
- **Creatinine = 2.6 mg/dL (0.6-1.1 mg/dL) (SI: 229.8 µmol/L [53.0-97.2 µmol/L])**
- **Sodium = 135 mEq/L (136-142 mEq/L) (SI: 135 mmol/L [136-142 mmol/L])**
- **Potassium = 2.5 mEq/L (3.5-5.0 mEq/L) (SI: 3.2 mmol/L [3.5-5.0 mmol/L])**
- **Magnesium = 1.7 mg/dL (1.5-2.3 mg/dL) (SI: 0.7 mmol/L [0.6-0.9 mmol/L])**
- **Phosphate = 3.6 mg/dL (2.3-4.7 mg/dL) (SI: 1.2 mmol/L [0.7-1.5 mmol/L])**
Which of the following is the best initial prescription in this patient’s management?

A. Give 6 units regular insulin intravenously and infuse 0.45% NaCl at 100 cc/h with 40 mEq KCl per L over 1 hour
B. Give 6 units regular insulin intravenously and infuse 1000 mL 0.9% NaCl with 40 mEq KCl over 1 hour
C. Infuse 1000 mL 0.45% NaCl with 40 mEq KCl over 1 hour
D. Infuse 1000 mL 0.9% NaCl with 40 mEq of KCl over 1 hour
E. Infuse 0.45% NaCl at 100 cc/h with 40 mEq of KCl per L

Correct Answer: D

Learning objective:
Recommend appropriate fluid and electrolyte management in the setting of diabetic ketoacidosis.
ITE 2019 Question 5

A 32-year-old woman who is 4 months postpartum following the birth of her second child is referred for evaluation. Graves disease was diagnosed 2 years earlier and this was initially treated with methimazole. Her antithyroid drug regimen was changed to propylthiouracil 3 months before she became pregnant, and antithyroid drug treatment was discontinued at 16 weeks’ gestation. She reports that she felt nauseated while taking propylthiouracil. The patient remained euthyroid during pregnancy but has now presented with a 4-week history of palpitations, weight loss of 11 lb (5 kg), heat intolerance, and tremulousness. She reports that she is breastfeeding her baby and she plans to continue.

On physical examination, her height is 68 in (172.7 cm) and weight is 150 lb (68.2 kg) (BMI = 22.8 kg/m2). Her blood pressure is 124/62 mm Hg, and pulse rate is 84 beats/min. There is a tremor of the outstretched hands, and her hands are moist. She has mild periorbital and conjunctival swelling. A small, soft, diffusely enlarged thyroid gland is palpable in her neck.

Laboratory test results:

- TSH = <0.01 mIU/L (0.5-5.0 mIU/L)
- Free T4 = 5.1 ng/dL (0.8-1.8 ng/dL) (SI: 65.6 pmol/L [10.30-23.17 pmol/L])
- Free T3 = 29.3 pg/mL (2.3-4.2 pg/mL) (SI: 45.01 pmol/L [3.53-6.45 pmol/L])
- TSH-receptor antibodies = 23.0 IU/L (≤1.75 IU/L)
Which of the following is the best next step in this patient’s management?

A. Start methimazole and continue breastfeeding  
B. Start propylthiouracil and continue breastfeeding  
C. Start propranolol and continue breastfeeding  
D. Recommend total thyroidectomy and continue breastfeeding  
E. Stop breastfeeding due to risk of hyperthyroidism in infant

Correct Answer: A

Learning objective:
Counsel a breastfeeding patient regarding the safety of antithyroid drugs.
ITE 2019 Question 6

A 66-year-old woman with type 2 diabetes mellitus has been taking metformin and liraglutide for the past 2 years. She has no personal history or family history of cardiovascular disease, but hypertension was recently diagnosed. Lisinopril was started and titrated to maximum dosing.

On physical examination, her seated blood pressure is 150/90 mm Hg, and pulse rate is 76 beats/min. Her weight is 174 lb (79.1 kg); she has lost 5.5 lb (2.5 kg) in the last year. Her BMI is 28.0 kg/m2.

Recent laboratory test results:

- Hemoglobin A1c = 6.4% (4.0%-5.6%) (46 mmol/mol [20-38 mmol/mol])
- Fasting blood glucose = 120 mg/dL (70-99 mg/dL) (SI: 6.7 mmol/L [3.9-5.5 mmol/L])
- Serum potassium = 3.8 mEq/L (3.5-5.0 mEq/L) (SI: 3.8 mmol/L [3.5-5.0 mmol/L])
- Serum creatinine = 1.0 mg/dL (0.6-1.1 mg/dL) (SI: 88.4 µmol/L [53.0-97.2 µmol/L])
In addition to maintaining lisinopril therapy, which of the following medications should be added to manage this patient’s blood pressure?

A. Amlodipine
B. Losartan
C. Metoprolol
D. Hydrochlorothiazide

Correct Answer: A

Learning objective:
Manage hypertension in patients with type 2 diabetes mellitus.
ITE 2019 Question 7

A 36-year-old woman with a peak lifetime BMI of 46 kg/m^2 had a laparoscopic gastric bypass operation in another state 8 weeks ago. She initially did well, but over the last 3 weeks she began to experience episodes of vomiting. Over the last 5 days, she has been vomiting almost everything she eats. Over the last 2 days, her husband says that she has become increasingly confused, dysarthric, and unsteady on her feet. On neurologic examination, she is clearly confused, has nystagmus, is unsteady on standing, has decreased sensation on her lower extremities, and has a right third nerve palsy.
This patient most likely has a deficiency of which of the following?

A. Vitamin $B_{12}$  
B. Folate  
C. Thiamine  
D. Zinc

Correct Answer: C

Learning objective:
Differentiate among the vitamin deficiencies that can occur after gastric bypass surgery.
ITE 2019 Question 8

A 21-year-old woman with a history of optic nerve glioma diagnosed at age 11 years would like to establish care with an adult endocrinologist. At diagnosis, the optic nerve glioma was treated surgically and she had postoperative radiotherapy (cumulative dose, 40 Gy) impacting the sellar region. She also developed complex partial epilepsy, which is now well controlled. She was treated with recombinant human GH from age 12 to 19 years. She feels well and has no concerns. Her periods are regular. She takes lamotrigine for epilepsy, but is on no other medications.

On physical examination, her height is 61 in (155 cm) and weight is 110 lb (50 kg) (BMI = 20.8 kg/m2). Breasts and pubic hair are Tanner stage 4. Her blood pressure is 102/68 mm Hg.

Her most recent laboratory testing was performed 2 years ago (when she was still on GH replacement):

- TSH = 1.4 mIU/L (0.5-5.0 mIU/L)
- Free T4 = 1.2 ng/dL (0.8-1.8 ng/dL) (SI: 15.4 pmol/L [10.30-23.17 pmol/L])
- Serum cortisol (8 AM) = 15.0 μg/dL (5-25 μg/dL) (SI: 413.8 nmol/L [137.9-689.7 nmol/L])
- IGF-1 = 205 ng/mL (116-341 ng/mL) (SI: 26.9 nmol/L [15.2-44.7 nmol/L])
- FSH = 8.0 mIU/mL (2.0-12.0 mIU/mL [follicular]) (SI: 8.0 IU/L [2.0-12.0 IU/L])
- LH = 12.0 mIU/mL (1.0-18.0 mIU/mL [follicular]) (SI: 12.0 IU/L [1.0-18.0 IU/L])
- Estradiol = 110 pg/mL (10-180 pg/mL [follicular]) (SI: 403.8 pmol/L [36.7-660.8 pmol/L])
Which of the following management strategies would you advise for this patient?

A. Annual evaluation of full pituitary function indefinitely
B. Annual evaluation of full pituitary function if symptomatic of hormonal deficiency
C. Annual screening of gonadotropins only
D. GHRH-arginine test
E. Insulin tolerance test

Correct Answer: A

Learning objective:
Counsel patients who have undergone cranial irradiation regarding the need for long-term (usually lifelong) screening of pituitary function.
ITE 2019 Question 9

A 45-year-old woman has a skin lesion on her left lower extremity (see image). A similar but smaller lesion is also present on her right lower extremity.

Biopsy documents an inflammatory granulomatous dermatitis with collagen degeneration and fat deposition.
Which of the following diagnoses does this patient most likely have?

A. Type 1 diabetes mellitus  
B. Graves disease  
C. Glucagonoma  
D. Pseudohypoparathyroidism  
E. Familial hypercholesterolemia

Correct Answer: A  
Learning objective:  
Diagnose necrobiosis lipoidica and recognize its association with diabetes mellitus.
A 25-year-old transgender man returns for follow-up after initiating masculinizing testosterone injections 9 months ago. He had regular monthly menses before initiation of testosterone. After 3 months of hormone therapy, menses ceased. However, for the past 2 months, bleeding has recurred intermittently despite no change in his hormone regimen.

Laboratory test result (assessment just before the current visit, midway between injections):

- Total testosterone = 343 ng/dL (300-900 ng/dL [male]; 0.3-1.9 ng/dL [female]) (SI: 11.9 nmol/L [10.4-31.2 nmol/L (male)]; 0.01-0.07 nmol/L (female))

His testosterone dosage is 50 mg subcutaneously weekly. He has already had a gynecologic examination and ultrasonography, and there is no evidence of infection or uterine abnormality. He is not currently sexually active.
Which of the following is the best option to stop the uterine bleeding?

A. Add oral estradiol  
B. Add oral progesterone  
C. Switch from subcutaneous to intramuscular testosterone therapy  
D. Insert a copper intrauterine device  
E. Increase the testosterone dosage

Correct Answer: E

Learning objective:  
Counsel transgender men taking masculinizing hormone therapy regarding management options for persistent or recurrent uterine bleeding.
ITE 2019 Question 11

A 56-year-old man with a 15-year history of type 2 diabetes mellitus complicated by peripheral neuropathy and microalbuminuria returns for follow-up. He required the addition of insulin to oral hypoglycemic agents soon after diagnosis. His insulin requirements have consistently increased since that time. His current medication regimen includes metformin, 1000 mg twice daily; insulin glargine, 65 units twice daily; and aspart insulin, 80 units 3 times daily with meals. He reports excellent adherence to his prescribed insulin regimen and monitors his fingerstick blood glucose levels 3 to 4 times daily. His carefully maintained blood glucose log reveals values ranging between 120 and 280 mg/dL (6.7-15.5 mmol/L). He has had no recent hypoglycemia and has never had problems with hypoglycemia unawareness.

On physical examination, his blood pressure is 128/87 mm Hg, and pulse rate is 85 beats/min. His height is 69 in (175.3 cm), and weight is 230 lb (104.5 kg) (BMI = 34 kg/m²).

Laboratory test results:

- Hemoglobin A₁c = 7.6% (4.0%-5.6%) (62 mmol/mol [20-38 mmol/mol])
- Creatinine = 1.0 mg/dL (0.7-1.3 mg/dL) (SI: 88.4 µmol/L [61.9-114.9 µmol/L])
- Estimated glomerular filtration rate = 82.2 mL/min per 1.73 m² (>60 mL/min per 1.73 m²)
The best next step in this patient’s care is to change his regimen to which of the following?

A. U500 regular insulin, 0.2 mL (100 units) 2 times daily before meals
B. U500 regular insulin, 0.15 mL (75 units) 3 times daily before meals
C. U500 regular insulin, 0.2 mL (100 units) 3 times daily before meals
D. U500 regular insulin, 0.25 mL (125 units) 3 times daily before meals
E. U500 regular insulin, 0.3 mL (150 units) 3 times daily before meals

Correct Answer: C

Learning objective:
Guide conversion from a U100 to a U500 regular insulin regimen in a patient with severe insulin resistance.
A 31-year-old man presents with abdominal pain near his umbilicus. He describes symptoms of bloating and central abdominal pain for several months. He has no notable medical history or past surgeries and takes no medications. He does not smoke cigarettes.

On physical examination, he is afebrile, blood pressure is 122/80 mm Hg, and pulse rate is 70 beats/min. His height is 69 in (175 cm), and weight is 148 lb (67.3 kg) (BMI = 21.9 kg/m2). He has no signs of Cushing syndrome and there is no palpable abdominal pain or mass.

Abdominal CT with intravenous contrast documents a heterogeneously enhancing right adrenal mass measuring 3.4 x 3.2 cm (see images, arrows). The mass is relatively round and confined to the right adrenal gland. The left adrenal gland appears normal.
He has no history of episodic spells of adrenergic symptoms, including no sensations of palpitations, sweating, anxiety, tremors, pallor, flushing, headaches, or vision changes. He has had no known episodes of hypertension or orthostasis and no history of weight gain, weight loss, excessive virilization, or feminization.

Laboratory test results:

Serum cortisol following 1-mg dexamethasone suppression test = 0.7 µg/dL (SI: 19.3 nmol/L)
Plasma ACTH following 1-mg dexamethasone suppression test = <5.0 pg/mL (SI: <1.1 pmol/L)
Plasma renin activity = 1.5 ng/mL per h (0.6-4.3 ng/mL per h)
Serum aldosterone = 5.0 ng/dL (4-21 ng/dL) (SI: 138.7 pmol/L [111.0-582.5 pmol/L])
Plasma metanephrine = <39 pg/mL (<99 pg/mL) (SI: <0.20 nmol/L [<0.50 nmol/L])
Plasma normetanephrine = 1245 pg/mL (<165 pg/mL) (SI: 6.8 nmol/L [<0.90 nmol/L])
Urinary free cortisol = 37 µg/24 h (4-50 µg/24 h) (SI: 102 nmol/d [11-138 nmol/d])
Which of the following is the most likely diagnosis?

A. Adrenocortical carcinoma  
B. Hyperfunctioning adrenocortical adenoma  
C. Nonfunctional lipid-poor adrenocortical adenoma  
D. Nonfunctional lipid-rich adrenocortical adenoma  
E. Pheochromocytoma

Correct Answer: E

Learning objective: 
Diagnose pheochromocytoma on the basis of radiographic and biochemical characteristics, even if a patient does not have classic adrenergic symptoms or spells.
A 27-year-old man seeks evaluation of infertility. The patient and his wife have been trying for pregnancy for the past 2 years without success. His wife has normal menstrual cycles and findings from a thorough gynecologic evaluation are normal. The couple has been timing sexual intercourse around her ovulation.

The patient underwent puberty at age 13 years and started shaving at the same time as his peers. He recalls some increase in testicular size at puberty along with development of bilateral gynecomastia, which has remained stable. His sense of smell is normal. He reports normal libido and erectile function. He had one previous partner but always used contraception during intercourse. He has psychosocial problems such as difficulty making new friends and he had difficulty learning in high school. He takes no medications.

On physical examination, he is a well-developed man without eunuchoid habitus. His blood pressure is 120/72 mm Hg, and BMI is 26.6 kg/m2. He has normal axillary and chest hair. There is bilateral, non-tender gynecomastia, 6 x 4 cm on the right side and 5 x 5 cm on the left side. There is no galactorrhea, nipple retraction, or skin discoloration. His cardiac auscultation is normal. His phallus and scrotum are normal. His testes are firm and 4 mL bilaterally. His muscle bulk is slightly reduced, but tone and power are normal.
Laboratory test results:

- Morning total testosterone (by tandem mass spectrometry) = 349 ng/dL (300-900 ng/dL) (SI: 12.1 nmol/L [10.4-31.2 nmol/L])
- TSH = 2.13 mIU/L (0.5-5.0 mIU/L)
- Azoospermia is documented on semen analysis (2 specimens, each taken after 3 days of abstinence). Another morning total testosterone measurement (1 week later) is 364 ng/dL (12.6 nmol/L).
Which of the following should be the next diagnostic step in this patient’s evaluation?

A. Measurement of dihydrotestosterone  
B. Testicular ultrasonography  
C. Measurement of gonadotropins  
D. Measurement of the testosterone-to-epitestosterone ratio  
E. Mammography  

Correct Answer: C

Learning objective:
Describe the clinical presentation of a man with mosaic Klinefelter syndrome and recommend appropriate diagnostic tests.
ITE 2019 Question 14

A 49-year-old man with a history of severe obesity and type 2 diabetes mellitus had a gastric bypass operation 3 years ago. His preoperative BMI was 42 kg/m². After surgery, his diabetes resolved and his insulin therapy was stopped. His weight decreased and stabilized at a BMI of 29 kg/m². He has had no follow-up for the last 16 months. Over the past month, he has had several episodes in which he felt shaky, sweaty, and irritable. Family members brought him to the emergency department for confusion that developed after he had a large breakfast at a buffet restaurant. In the emergency department, his glucose concentration was documented to be 35 mg/dL (1.9 mmol/L).
After treating his acute decompensation, which of the following is the most appropriate next treatment?

A. Dietary modification
B. Partial pancreatectomy
C. Octreotide
D. Acarbose

Correct Answer: A
Learning objective:
Manage hyperinsulinemic hypoglycemia that develops after gastric bypass surgery.
A 20-year-old woman seeks additional evaluation of delayed puberty. She was first evaluated at age 16 years because of primary amenorrhea and lack of breast development. Her initial evaluation included a head MRI that showed no pituitary abnormality, as well as the laboratory results shown in the table. No hormone therapy was started at that time. At age 17 years, her examination findings were still consistent with Tanner stage 1 development, and test results showed no change in gonadotropin or estradiol concentrations. She began taking estradiol, 0.5 mg every other day. Every 6 months, therapy was discontinued for 3 months to see if spontaneous pubertal progression might occur. The initial 2 years of therapy were associated with development of pubic hair only. At a follow-up visit 6 months ago, the estradiol dosage was increased to 0.5 mg daily. She has noticed initial breast development with this most recent dosage change. Her sense of smell is normal. Her mother’s height is 66 in (167.6 cm) and her father’s height is 72 in (182.9 cm).

On physical examination, her height is 62 in (157.5 cm) and weight is 105 lb (47.7 kg) (BMI = 19.2 kg/m²). Breasts and pubic hair distribution are consistent with Tanner stage 2 development.

Pelvic ultrasonography shows a smaller-than-normal uterus and ovaries with tiny follicles.
<table>
<thead>
<tr>
<th>Measurement</th>
<th>16 Years</th>
<th>17 Years</th>
<th>20 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FSH</strong></td>
<td>1.6 mIU/mL (SI: 1.6 IU/L)</td>
<td>1.5 mIU/mL (SI: 1.5 IU/L)</td>
<td>1.0 mIU/mL (SI: 1.0 IU/L)</td>
</tr>
<tr>
<td><strong>LH</strong></td>
<td>0.5 mIU/mL (SI: 0.5 IU/L)</td>
<td>0.4 mIU/mL (SI: 0.4 IU/L)</td>
<td>0.5 mIU/mL (SI: 0.5 IU/L)</td>
</tr>
<tr>
<td><strong>Estradiol</strong></td>
<td>17 pg/mL (SI: 62.4 pmol/L)</td>
<td>2 pg/mL (SI: 7.3 pmol/L)</td>
<td>29 pg/mL (SI: 106.5 pmol/L)</td>
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<tr>
<td><strong>Prolactin</strong></td>
<td>6.8 ng/mL (SI: 0.30 nmol/L)</td>
<td>8.0 ng/mL (SI: 0.35 nmol/L)</td>
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</tr>
<tr>
<td><strong>TSH</strong></td>
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<td>2.0 mIU/L</td>
<td>…</td>
</tr>
<tr>
<td><strong>Total T4</strong></td>
<td>…</td>
<td>6.7 µg/dL (SI: 86.2 nmol/L)</td>
<td>…</td>
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<tr>
<td><strong>ACTH</strong></td>
<td>…</td>
<td>…</td>
<td>23 pg/mL (SI: 5.1 pmol/L)</td>
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<tr>
<td><strong>Cortisol (8 AM)</strong></td>
<td>…</td>
<td>…</td>
<td>12 µg/dL (SI: 331.1 nmol/L)</td>
</tr>
<tr>
<td><strong>IGF-1</strong></td>
<td>…</td>
<td>…</td>
<td>132 ng/mL (SI: 17.3 nmol/L)</td>
</tr>
<tr>
<td><strong>Bone age</strong></td>
<td>13 years</td>
<td>13 years</td>
<td>14 years</td>
</tr>
</tbody>
</table>

Reference ranges: FSH <3.0 mIU/mL (<3.0 IU/L) (prepubertal); LH <1.0 mIU/mL (<1.0 IU/L) (prepubertal); estradiol 10-180 pg/mL (36.7-660.8 pmol/L) (follicular, premenopausal); prolactin, 4-30 ng/mL (0.17-1.30 nmol/L); TSH, 0.5-5.0 mIU/L; total T4, 5.5-12.5 µg/dL (94.02-213.68 nmol/L); ACTH, 10-60 pg/mL (2.2-13.2 pmol/L); cortisol (8 AM), 5-25 µg/dL (137.9-689.7 nmol/L); IGF-1, 122-384 ng/mL (16.0-50.3 nmol/L).
Which of the following is the best next step in this patient’s management?

A. Change to an oral contraceptive  
B. Add micronized progesterone, 100 mg daily  
C. Start GH therapy  
D. Increase the estradiol dosage  
E. Discontinue estradiol and observe for 3 months

Correct Answer: D

Learning objective:
Select the appropriate hormone therapy when a woman with delayed puberty and idiopathic hypogonadotropic hypogonadism presents as an adult.
ITE 2019 Question 16

A 52-year-old woman is referred for evaluation after a DXA scan shows osteoporosis at the hip, with right femoral neck and total hip T-scores of –3.5 and –3.0, respectively. The lumbar spine T-score is –1.6.

She has a history of recurrent metatarsal stress fractures without significant trauma. She underwent natural menopause 1 year ago and has not taken hormone therapy. She takes calcium, 600 mg twice daily, and cholecalciferol, 2000 IU daily, but no multivitamin or additional supplements. Review of systems is notable for multiple previous tooth extractions due to poor dentition and ongoing mild but vague right upper thigh pain. She reports her mother had a femoral fracture in her 50s.

On physical examination, she has no significant height loss. She has multiple missing teeth. She has mild tenderness to palpation over the right anterolateral upper femur. There is no evident thoracic kyphosis.
Laboratory test results:

- Serum calcium = 9.5 mg/dL (8.2-10.2 mg/dL) (SI: 2.4 mmol/L [2.1-2.6 mmol/L])
- Serum phosphate = 4.0 mg/dL (2.3-4.7 mg/dL) (SI: 1.3 mmol/L [0.7-1.5 mmol/L])
- Serum albumin = 4.0 mg/dL (3.5-5.0 g/dL) (SI: 40 g/L [35-50 g/L])
- Serum creatinine = 1.0 mg/dL (0.6-1.1 mg/dL) (SI: 88.4 µmol/L [53.0-97.2 µmol/L])
- Serum intact PTH = 45 pg/mL (10-65 pg/mL) (SI: 45 ng/L [10-65 ng/L])
- Serum 25-hydroxyvitamin D = 48 ng/mL (25-80 ng/mL) (SI: 119.8 nmol/L [62.4-199.7 nmol/L])
- Serum alkaline phosphatase = 30 U/L (50-120 U/L) (SI: 0.5 µkat/L [0.84-2.00 µkat/L])
- Serum liver transaminases normal
- Urinary calcium = 200 mg/24 h (100-300 mg/24 h) (SI: 5.0 mmol/d [2.5-7.5 mmol/d])
- Urinary creatinine = 1.2 g/24 h (1.0-2.0 g/24 h) (SI: 10.6 mmol/d [8.8-17.7 mmol/d])
Which of the following is this patient’s most likely diagnosis?

A. Osteogenesis imperfecta type 1
B. Paget disease of bone
C. Hypophosphatasia
D. X-linked hypophosphatemic rickets
E. Osteoporosis

Correct Answer: C

Learning objective:
Identify the clinical signs and laboratory findings that are characteristic of hypophosphatasia.
ITE 2019 Question 17

A 42-year-old man seeks follow-up of diabetes mellitus that was diagnosed during a hospitalization 3 months ago when he presented with polyuria, shortness of breath, and abdominal pain. He reports that at the time of initial presentation, his blood glucose concentration was 700 mg/dL (38.9 mmol/L) and his hemoglobin A1c level was 12.0% (108 mmol/mol). Outside hospital records document that he had marked metabolic acidosis and ketonemia on admission. He was treated with intravenous insulin and was discharged 4 days later on insulin glargine, 10 units at bedtime daily. He has not been monitoring his blood glucose at home, but he reports feeling that his blood glucose is low most mornings.

His medical history is unremarkable, and his family history is notable for type 2 diabetes diagnosed in his father at age 65 years.

On physical examination, his blood pressure is 122/73 mm Hg and BMI is 32 kg/m2. The rest of his examination findings are unremarkable.
Which of the following sets of measurements would most accurately predict this patient’s need for long-term insulin management?

A. BMI, glutamic acid decarboxylase antibodies, and islet antigen-2 antibodies
B. Glutamic acid decarboxylase antibodies, hemoglobin A1c, and islet antigen-2 antibodies
C. BMI, fasting C-peptide, and hemoglobin A1c
D. Fasting C-peptide, glutamic acid decarboxylase antibodies, and islet antigen-2 antibodies

Correct Answer: D

Learning objective:
Choose the appropriate classification system for predicting duration of insulin therapy in ketosis-prone diabetes.
ITE 2019 Question 18

An 85-year-old man comes to the clinic for evaluation of a 3-year history of decreased libido, loss of morning erections, fatigue, and loss of muscle mass. His exercise tolerance has also decreased. He saw his primary care physician who checked an afternoon serum total testosterone concentration, which was 84 ng/dL (300-900 ng/dL) (SI: 2.9 nmol/L [10.4-31.2 nmol/L]).

The patient is retired and lives with his girlfriend. He has no history of androgen disorders. He has 2 biologic children and 5 grandchildren. He has no gynecomastia and has not noticed decreased shaving frequency. His medical history is notable for hypertension, benign prostatic hypertrophy, and bilateral epididymal cysts. He takes a calcium-channel blocker and a 5α-reductase inhibitor.

On physical examination, the patient looks younger than his stated age. His blood pressure is 132/79 mm Hg, pulse rate is 74 beats/min, and BMI is 28.6 kg/m2. He does not have a cushingoid face. His visual fields are normal to confrontation. There is no gynecomastia. There are no abdominal striae. His testes are 25 mL bilaterally. His prostate is symmetric and moderately enlarged without any nodules or induration. Muscle power is slightly decreased.
Laboratory test results (8 AM):

- Testosterone (by tandem mass spectrometry) = 52 ng/dL (300-900 ng/dL) (SI: 1.8 nmol/L [10.4-31.2 nmol/L])
- LH = 3.3 mIU/mL (1.0-9.0 mIU/mL) (SI: 3.3 IU/L [1.0-9.0 IU/L])
- Prolactin = 6.8 ng/mL (4-23 ng/mL) (SI: 0.3 nmol/L [0.17-1.00 nmol/L])
- TSH = 2.58 mIU/L (0.5-5.0 mIU/L)
- Free T4 = 1.2 ng/dL (0.8-1.8 ng/dL) (SI: 15.4 pmol/L [10.30-23.17 pmol/L])
- Cortisol = 10.7 µg/dL (5-25 µg/dL) (SI: 295.2 nmol/L [137.9-689.7 nmol/L])
- IGF-1 = 41 ng/mL (53-162 ng/mL) (SI: 5.4 nmol/L [6.9-21.2 nmol/L])
- PSA = 2.4 ng/mL (<7.2 ng/mL) (SI: 2.4 µg/L [<7.2 µg/L])
Which of the following is the best next step in the evaluation of this androgen-deficient patient?

A. Inhibin B measurement
B. GH measurement
C. Scrotal ultrasonography
D. Free testosterone measurement
E. MRI of the sella

Correct Answer: E

Learning objective:
Recommend MRI of the sella in patients with profound secondary hypogonadism
A 36-year-old man is referred for evaluation of abnormal results on thyroid function tests that were obtained during the workup of palpitations. He has no relevant medical history. His family history is notable for his mother having had “a thyroid problem.” He has no siblings. He takes no medications.

On physical examination, his blood pressure is 128/85 mm Hg and pulse rate is 90 beats/min. He has very mild tremors when his hands are extended. His thyroid is palpable, but not obviously enlarged. There is no stare or lid lag.

- Free T4 = 1.9 ng/dL (0.8-1.8 ng/dL) (SI: 24.5 pmol/L [10.30-23.17 pmol/L])
- Total T3 = 210 ng/dL (70-200 ng/dL) (SI: 3.2 nmol/L [1.08-3.08 nmol/L])
- TSH = 5.3 mIU/L (0.5-5.0 mIU/L)

You confirm these tests and order the following:

- SHBG = 7.5 µg/mL (1.1-6.7 µg/mL) (SI: 66.7 nmol/L [10-60 nmol/L])
- α-Subunit = 5.2 ng/mL (<1.2 ng/mL) (SI: 5.2 µg/L [<1.2 µg/L])

Pituitary MRI shows an 8-mm right-sided pituitary adenoma.
Which of the following is the best next step in this patient’s management?

A. Initiation of somatostatin analogue as long-term therapy
B. Initiation of methimazole as long-term therapy
C. Genetic testing for a pathogenic variant in the thyroid hormone receptor β gene
D. T₃ suppression test
E. Referral for neurosurgery

Correct Answer: E

Learning objective:
Distinguish between a TSH-secreting adenoma and thyroid hormone resistance and recommend surgery as the primary therapy for TSH-secreting microadenomas.
A 23-year-old man seeks evaluation of high cholesterol. He was seen at a local health fair where he was told that his cholesterol was extremely high and that he should seek care.

On physical examination he has small yellowish papules on his abdomen, lower back, and the extensor surfaces of his arms.

Fasting lipid panel:

- Total cholesterol = 325 mg/dL (<200 mg/dL [optimal]) (SI: 8.42 mmol/L [<5.18 mmol/L])
- Triglycerides = 3450 mg/dL (<150 mg/dL [optimal]) (SI: 38.99 mmol/L [<1.70 mmol/L])
- HDL cholesterol = 30 mg/dL (>60 mg/dL [optimal]) (SI: 0.78 mmol/L [>1.55 mmol/L])
- LDL cholesterol, cannot be calculated
Which of the following abnormalities does this man most likely have?

A. ATP-binding cassette A1 (ABCA1) deficiency  
B. LDL-receptor deficiency  
C. Apolipoprotein E2/E2  
D. Lipoprotein lipase deficiency  
E. Overproduction of apolipoprotein B

Correct Answer: D

Learning objective: 
Identify the clinical features of genetic hyperlipidemias.
ITE 2019 Question 21

A 55-year-old woman is referred for evaluation of multiple fractures. She entered menopause 3 years ago and has not taken hormone therapy. During childhood and adolescence, she sustained several long-bone fractures that were attributed to her active lifestyle and participation in sports, but she had no additional fractures until recently. Since menopause, she has sustained fractures at the wrist, humerus, and femur in low-trauma falls. Recent DXA reveals T-scores of −3.0 at the spine, −2.8 at the femoral neck, and −2.7 at the total hip. Her mother was diagnosed with osteoporosis at age 65 years.

On physical examination, she is a well-appearing woman with no dysmorphic features. Her height is 65 in (165.1 cm). Sclerae appear slightly bluish. She has no joint deformities or laxity. Her dentition appears normal. She wears bilateral hearing aids.

Laboratory test results are normal for the following: complete blood cell count, comprehensive chemistry panel (including liver function and alkaline phosphatase), thyroid function, 25-hydroxyvitamin D, 1,25-dihydroxyvitamin D, and intact PTH.
Which of the following tests will establish the diagnosis?

A. Bone-specific alkaline phosphatase measurement
B. Sequencing of type 1 collagen α 1 and 2 genes (COL1A1/COL1A2)
C. Sequencing of the chloride channel 7 gene (CLCN7)
D. Sequencing of the vitamin D receptor gene (VDR)
E. Tetracycline-labeled bone biopsy of the iliac crest

Correct Answer: B

Learning objective:
Diagnose osteogenesis imperfecta type 1 (the mildest form).
A 62-year-old transgender woman is referred for management of gender dysphoria. The patient reports being in denial of her gender identity for much of her life. At age 53 years, she established care with both a psychologist and psychiatrist after suffering an emotional breakdown. At that time, she came out as transgender to these mental health professionals. She then came out to family and friends 2 years later. At age 56, she began cross-sex hormone therapy with estrogen and antiandrogens. She has been on numerous estrogen formulations, including oral, sublingual, transdermal, and intramuscular. Despite attempts with different doses and formulations of estrogen, her testosterone and estradiol levels have never reached target. She was advised to discontinue hormone therapy for 3 weeks to reassess baseline testosterone, after which treatment was resumed as outlined in the table.

On physical examination, her height is 69 in (175 cm) and weight is 185 lb (84 kg) (BMI = 27.3 kg/m2). Her blood pressure is 145/88 mm Hg, and pulse rate is 85 beats/min. Her physical examination findings are notable for a testicular volume of 15 mL bilaterally and sparse body hair.
Laboratory test results:

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Treatment Regimen</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Spironolactone: 100 mg twice daily</td>
</tr>
<tr>
<td>Estradiol: 2 mg</td>
<td>Estradiol: 4 mg daily Spironolactone: 200 mg twice</td>
</tr>
<tr>
<td>Estradiol: 4 mg</td>
<td>daily Spironolactone: 100 mg twice daily</td>
</tr>
<tr>
<td>Estradiol: 2 mg</td>
<td>daily Spironolactone: 200 mg twice daily</td>
</tr>
</tbody>
</table>

| Serum estradiol   | Spironolactone: 100 mg twice daily                     |
| Not measured      | Not measured                                           |
| 37 pg/mL (SI: 135.8 pmol/L) | 35 pg/mL (SI: 128.5 pmol/L)                       |

| Serum testosterone| Spironolactone: 100 mg twice daily                     |
| 977 ng/dL (SI: 33.9 nmol/L) | 677 ng/dL (SI: 23.5 nmol/L)                           |
| 506 ng/dL (SI: 17.6 nmol/L) | 580 ng/dL (SI: 20.1 nmol/L)                           |

Reference ranges (female): estradiol: 10-180 pg/mL (SI: 36.7-660.8 pmol/L); testosterone: 8-60 ng/dL (SI: 0.3-2.1 nmol/L).
Which of the following is the best next step in this patient’s management?

A. Increase the estradiol dosage
B. Increase the estradiol and spironolactone dosages
C. Switch the mode of estradiol delivery from oral to sublingual
D. Recommend the addition of progesterone
E. Recommend elective orchiectomy

Correct Answer: E

Learning objective:
Identify appropriate treatment strategies to normalize testosterone levels in transgender women.
ITE 2019 Question 23

A 19-year-old man presents for continued management of type 1 diabetes mellitus, having “aged-out” of pediatric endocrine care. Diabetes was diagnosed at age 16 years when glycosuria and moderate hyperglycemia were found on a yearly checkup. Insulin therapy was started immediately. His current insulin dose is approximately 0.4 units/kg per day, administered as multiple daily injections, and his current hemoglobin A1c level is 6.4% (46 mmol/mol) with occasional hypoglycemia. His family history is positive for diabetes in his mother, maternal grandfather, and an older sibling. His BMI is 23 kg/m2.

Tests for glutamic acid decarboxylase antibodies, islet-cell antibodies, and insulinoma-associated protein 2 (IA-2) antibodies are negative, although he did not have antibody testing at diagnosis.
Optimal management of this patient’s diabetes will most likely include which of the following?

A. Insulin administration via a continuous subcutaneous insulin infusion pump
B. Addition of pramlintide
C. Discontinuation of insulin and initiation of metformin
D. Discontinuation of insulin and initiation of glimepiride

Correct Answer: D

Learning objective:
Diagnose monogenic diabetes mellitus that was initially misdiagnosed as type 1 diabetes and assess the treatment implications.
A 56-year-old man is referred for evaluation of obesity. His medical history is notable for HIV, treated with antiretroviral therapy. His viral load is undetectable, and he has no history of opportunistic infections. He also has hypertension and dyslipidemia. On review of systems, he had steady weight gain of 50 lb (22.7 kg) over the past 10 years. His father died of heart disease at age 45 years, and his mother has hypertriglyceridemia. Current medications include a once-daily combination pill for antiretroviral therapy and atorvastatin, 10 mg daily.

On physical examination, his blood pressure is 130/80 mm Hg and pulse rate is 80 beats/min. His height is 66.5 in (169 cm), and weight is 220 lb (100 kg) (BMI = 35 kg/m²). He has moderate truncal obesity and no lipoatrophy.

Laboratory test results:
- LDL cholesterol = 180 mg/dL (<100 mg/dL [optimal]) (SI: 4.66 mmol/L [<2.59 mmol/L])
- HDL cholesterol = 25 mg/dL (>60 mg/dL [optimal]) (SI: 0.65 mmol/L [>1.55 mmol/L])
- Triglycerides = 450 mg/dL (<150 mg/dL [optimal]) (SI: 5.09 mmol/L [<1.70 mmol/L])
Measurement of which of the following is the best method to screen for the presence of diabetes mellitus in this patient?

A. C-peptide
B. Random glucose
C. Hemoglobin A$_{1c}$
D. Fructosamine
E. Fasting glucose

Correct Answer: E

Learning objective:
Recommend appropriate screening for diabetes mellitus in a patient with HIV infection.
A 71-year-old man with hypothyroidism is admitted to the hospital after a stroke. As an outpatient, he was taking levothyroxine, 88 mcg daily. His 2 most recent TSH measurements (while on this dosage of levothyroxine) were 3.2 and 4.1 mIU/L. He has not yet resumed oral medication or feeding because of his persistent swallowing difficulties. Currently, he is receiving continuous tube feedings and medications are being delivered via the nasogastric tube.
On physical examination, his thyroid gland is small, without palpable nodules. Laboratory data from his hospital stay are shown (see table).

<table>
<thead>
<tr>
<th>Measurement</th>
<th>1 Week</th>
<th>2 Weeks</th>
<th>3 Weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TSH (0.5-5.0 mIU/L)</strong></td>
<td>15.7 mIU/L</td>
<td>23.0 mIU/L</td>
<td>35.0 mIU/L</td>
</tr>
<tr>
<td><strong>Free T$_4$ (0.8-1.8 ng/dL [SI: 10.30-23.17 pmol/L])</strong></td>
<td>…</td>
<td>0.6 ng/dL (SI: 7.7 pmol/L)</td>
<td>0.5 ng/dL (SI: 6.4 pmol/L)</td>
</tr>
<tr>
<td><strong>Total T$_3$ (70-200 ng/dL [SI: 1.08-3.08 nmol/L])</strong></td>
<td>…</td>
<td>…</td>
<td>60 ng/dL (SI: 0.9 nmol/L)</td>
</tr>
<tr>
<td><strong>Levothyroxine dosage</strong></td>
<td>88 mcg daily</td>
<td>100 mcg daily</td>
<td>112 mcg daily</td>
</tr>
</tbody>
</table>
Which of the following is the best management plan for this patient?

A. Switch his thyroid hormone replacement to liothyronine, 25 mcg orally twice daily
B. Add liothyronine, 5 mcg orally twice daily
C. Increase his oral levothyroxine dosage to 250 mcg daily
D. Switch his regimen to levothyroxine, 75 mcg daily given intravenously
E. Administer intravenous potassium iodine

Correct Answer: D

Learning objective:
Manage levothyroxine therapy in a hospitalized patient receiving enteral feeding.
ITE 2019 Question 26

A 59-year-old man is 8 months status post non–q-wave myocardial infarction. After atorvastatin, 80 mg daily, was prescribed, his LDL-cholesterol level decreased dramatically. However, he developed pain in his lower extremities and a rise in his creatine kinase level twice the upper normal limit. He stopped the atorvastatin and the pain resolved. His TSH level is normal. His triglyceride level has been in the range of 220 to 270 mg/dL (2.49-3.05 mmol/L) each time it has been checked since his myocardial infarction.
Which of the following medications should be started as the best next step in this patient’s management?

A. Rosuvastatin, 10 mg daily
B. Fenofibrate, 145 mg daily
C. Ezetimibe, 10 mg daily
D. Evolocumab, 420 mg subcutaneously once monthly
E. Niacin, 1000 mg daily

Correct Answer: A

Learning objective:
Recommend options for managing statin-associated muscle pain.
ITE 2019 Question 27

A 53-year-old man presents for evaluation after having a kidney stone. Stone analysis reveals calcium oxalate. He has normal serum calcium and PTH levels, with a 24-hour urinary calcium excretion of 335 mg/24 h (100-300 mg/24 h) (SI: 8.4 mmol/d [2.5-7.5 mmol/d]), but normal 24-hour urinary oxalate, uric acid, sodium, and citrate levels. His urine volume is 1650 mL/24 h.
Which of the following recommendations would provide the greatest reduction in his risk of future calcium oxalate stone disease?

A. Increased fluid intake
B. Reduced dietary sodium
C. Reduced dietary oxalate
D. Potassium citrate
E. Hydrochlorothiazide

Correct Answer: A

Learning objective:
Recommend increased fluid intake as a means to reduce the risk of a second kidney stone.
A 16-year-old girl presents with primary amenorrhea. She underwent thelarche at age 10 years but had no axillary or pubic hair development. She has had no hot flashes, acne, hirsutism, galactorrhea, or symptoms of thyroid disease, and she is not sexually active.

On physical examination, her blood pressure is 110/80 mm Hg. Her weight is 147 lb (66.8 kg), and height is 69 in (175.3 cm) (BMI = 21.7 kg/m2). On skin examination, she has no axillary or pubic hair. Her breasts are Tanner stage 4. No masses are noted on abdominal examination. Pelvic examination reveals a vaginal length of 1.5 cm. A mass is palpated in the right inguinal area.
Laboratory test results:

- **TSH** = 3.72 mIU/L (0.5-5.0 mIU/L)
- **Prolactin** = 8.6 ng/mL (4-30 ng/mL) (SI: 0.37 nmol/L [0.17-1.30 nmol/L])
- **FSH** = 3.2 mIU/mL (<3.0 mIU/mL [prepubertal]; 2.0-12.0 mIU/mL [follicular]; 4.0-36.0 mIU/mL [midcycle]; 1.0-9.0 mIU/mL [luteal]; >30 mIU/mL [postmenopausal]) (SI: 3.2 IU/L [<3.0 IU/L (prepubertal); 2.0-12.0 IU/L (follicular); 4.0-36.0 IU/L (midcycle); 1.0-9.0 IU/L (luteal); >30 IU/L (postmenopausal)])
- **LH** = 15.0 mIU/mL (<1.0 mIU/mL [prepubertal]; 1.0-18.0 mIU/mL [follicular]; 20.0-80.0 mIU/mL [midcycle]; 0.5-18.0 mIU/mL [luteal]; >30 mIU/mL [postmenopausal]) (SI: 15.0 IU/L [<1.0 IU/L (prepubertal); 1.0-18.0 IU/L (follicular); 20.0-80.0 IU/L (midcycle); 0.5-18.0 IU/L (luteal); >30 IU/L (postmenopausal)])
- **Testosterone** = 390 ng/dL (8-60 ng/dL) (SI: 13.5 nmol/L [0.3-2.1 nmol/L])
- **Estradiol** = 45 pg/mL (10-180 pg/mL [follicular]; 100-300 pg/mL [midcycle]; 40-200 pg/mL [luteal]; <20 pg/mL [postmenopausal]) (SI: 165.2 pmol/L [36.7-660.8 pmol/L (follicular); 367.1-1101.3 pmol/L (midcycle); 146.8-734.2 pmol/L (luteal); <73.4 pmol/L (postmenopausal)])
- **β-hCG** = <3.0 mIU/mL (<3.0 mIU/mL) (SI: <3.0 IU/L [<3.0 mIU/mL])
- **Karyotype**: 46,XY
Which of the following is the best next step in this patient’s management?

A. Prescribe transdermal estradiol
B. Refer for gonadectomy
C. Prescribe low-dosage oral contraceptive
D. Prescribe spironolactone
E. Prescribe micronized progesterone

Correct Answer: B

Learning objective:
Recommend management for a woman with complete androgen insensitivity syndrome.
ITE 2019 Question 29

A 68-year-old man with a history of ulcerative colitis and benign prostatic hypertrophy presents with fatigue, a 22-lb (10-kg) weight loss, diarrhea, anorexia, and increasing nocturia. His fasting blood glucose level is 236 mg/dL (13.1 mmol/L). One year ago, a random blood glucose measurement was 115 mg/dL (6.4 mmol/L).

On physical examination, he is a cachectic elderly man with a violaceous rash across his feet (see image) that has been unsuccessfully treated with topical clotrimazole.

Laboratory analysis is notable for anemia and low levels of zinc and essential fatty acids.
Measurement of which of the following is most likely to reveal the etiology of his diabetes?

A. Glucagon  
B. Somatostatin  
C. CA 19-9  
D. 24-Hour urinary free cortisol

Correct Answer: A  
Learning objective:  
Diagnose glucagonoma as a secondary cause of diabetes mellitus.
ITE 2019 Question 30

A 42-year-old man is noted to have a serum TSH value of 12.1 mIU/L (0.5-5.0 mIU/L). He is asymptomatic and physical examination findings are normal.

Further laboratory test results:

- Free T4 = 1.3 ng/dL (0.8-1.8 ng/dL) (SI: 16.7 pmol/L [10.30-23.17 pmol/L])
- TPO antibodies, negative
- Thyroglobulin antibodies, negative

Thyroid ultrasonography is normal.

One of the patient’s 2 children has similar laboratory test results.
Which of the following is the most likely source of this patient’s thyroid abnormality?

A. TSH resistance
B. Hashimoto thyroiditis
C. Adrenal insufficiency
D. Resistance to thyroid hormone
E. Excess selenium exposure

Correct Answer: A

Learning objective:
Distinguish resistance to thyrotropin from subclinical hypothyroidism.
ITE 2019 Question 31

A 46-year-old man is referred for evaluation of resistant hypertension. Chlorthalidone was discontinued 1 month ago due to hypokalemia. He is currently treated with amlodipine, benazepril, carvedilol, and hydralazine. On this regimen, he was screened for primary aldosteronism 1 week ago.

Laboratory test results:

Sodium = 139 mEq/L (136-142 mEq/L) (SI: 139 mmol/L [136-142 mmol/L])
Potassium = 2.9 mEq/L (3.5-5.0 mEq/L) (SI: 2.9 mmol/L [3.5-5.0 mmol/L])
Serum aldosterone = 8 ng/dL (4-21 ng/dL) (SI: 221.9 pmol/L [111.0-582.5 pmol/L])
Plasma renin activity = 0.8 ng/mL per h (0.6-4.3 ng/mL per h)
Which of the following should be your next step on the basis of these test results?

A. No further testing; primary aldosteronism has been excluded
B. Rescreen after correcting hypokalemia
C. Rescreen after stopping hydralazine
D. Rescreen after substituting doxazosin for amlodipine
E. Proceed to adrenal venous sampling

Correct Answer: B
Learning objective:
IDENTIFY CAUSES OF FALSE-NEGATIVE SCREENING FOR PRIMARY ALDOSTERONISM.
ITE 2019 Question 32

A 57-year-old postmenopausal woman is referred for management of cardiovascular risk. Eleven months ago, she had advanced lipid testing through her naturopathic primary care provider’s office and was found to have elevated lipoprotein (a) levels. At the time, she was told that her cardiovascular risk was very high and was prescribed a medication, which she did not start. Recently, she developed chest tightness; cardiac workup was unrevealing with no evidence of clinical cardiovascular disease. She takes alprazolam for generalized anxiety disorder and several dietary supplements, but no other medications. She does not smoke cigarettes, and she drinks 2 to 4 alcoholic beverages a week. She exercises regularly. Her father had a stroke at age 57 years, and a paternal uncle had a stroke at age 60 years. Her paternal grandmother underwent 2-vessel coronary bypass surgery and aortic valve replacement at age 72 years.

On physical examination, she is a healthy, anxious-appearing woman. Her blood pressure is 106/68 mm Hg. Her height is 68 in (172.7 cm), and weight is 163 lb (74 kg) (BMI = 24.8 kg/m2). The rest of her examination findings are normal.
Laboratory test results (sample drawn while fasting, no treatment):

- **Total cholesterol** = 197 mg/dL (<200 mg/dL [optimal]) (SI: 5.10 mmol/L [<5.18 mmol/L])
- **Triglycerides** = 65 mg/dL (<150 mg/dL [optimal]) (SI: 0.73 mmol/L [<1.70 mmol/L])
- **HDL cholesterol** = 86 mg/dL (>60 mg/dL [optimal]) (SI: 2.23 mmol/L [>1.55 mmol/L])
- **LDL cholesterol** = 98 mg/dL (<100 mg/dL [optimal]) (SI: 2.54 mmol/L [<2.59 mmol/L])
- **Non-HDL cholesterol** = 111 mg/dL (<130 mg/dL [optimal]) (SI: 2.87 mmol/L [<3.37 mmol/L])
- **Apolipoprotein B** = 83 mg/dL (50-110 mg/dL) (SI: 0.83 g/dL [0.5-1.1 g/dL])
- **Lipoprotein (a)** = 50 mg/dL (≤30 mg/dL) (>95th percentile for Caucasians) (SI: 1.79 µmol/L [≤1.07 µmol/L])
- **Hemoglobin A1c** = 5.5% (4.0%-5.6%) (37 mmol/mol [20-38 mmol/mol])
- **TSH** = 2.38 mIU/L (0.5-5.0 mIU/L)
- **Fasting plasma glucose** = 90 mg/dL (70-99 mg/dL) (SI: 5.0 mmol/L [3.9-5.5 mmol/L])

Her 10-year atherosclerotic cardiovascular disease risk is 1.1% based on the American College of Cardiology/American Heart Association cardiovascular risk calculator.
Which of the following is the best next step in this patient’s management?

A. Start low-dosage aspirin
B. Start a statin
C. Start niacin
D. Start a PCSK9 inhibitor
E. No therapy is necessary now

Correct Answer: B

Learning objective:
Manage increased cardiovascular risk in an individual with elevated lipoprotein (a) levels.
Which of the following should be your next step on the basis of these test results?

A. No further testing; primary aldosteronism has been excluded
B. Rescreen after correcting hypokalemia
C. Rescreen after stopping hydralazine
D. Rescreen after substituting doxazosin for amlodipine
E. Proceed to adrenal venous sampling

Correct Answer: B

Learning objective:
IDENTIFY CAUSES OF FALSE-NEGATIVE SCREENING FOR PRIMARY ALDOSTERONISM.
ITE 2019 Question 33

A 62-year-old woman with osteoporosis seeks evaluation for left leg pain. She has taken alendronate for the past 7 years; in addition, she took hormone therapy from age 52 to 60 years for menopausal symptoms. She has been adherent to her calcium and vitamin D regimen. Until 3 months ago when she developed left leg pain, she had been walking 20 minutes 3 times weekly. There had been no change in her exercise pattern or frequency before the pain started. At that time, her primary care physician gave her crutches and prescribed no weight-bearing for 3 months. Despite this rest period, her left leg continues to hurt.

On physical examination, her BMI is 27 kg/m2. When she walks, she has an antalgic gait. She has no pain in the contralateral thigh.
DXA documents T-scores of −2.0 at the lumbar spine and −1.7 at the right femoral neck. Bone mineral density at the spine and mean total hip sites are both statistically unchanged from a DXA performed 2 years earlier. Plain film of the left femur is shown (see image).
Laboratory test results:

Urinary N-telopeptide = 31 nmol BCE/mmol creat (26-124 nmol BCE/mmol creat [postmenopausal])
Serum creatinine = 0.73 mg/dL (0.6-1.1 mg/dL) (SI: 64.5 µmol/L [53.0-97.2 µmol/L])
Calcium = 10 mg/dL (8.2-10.2 mg/dL) (SI: 2.5 mmol/L [2.1-2.6 mmol/L])
Alkaline phosphatase = 105 U/L (50-120 U/L) (SI: 1.75 µkat/L [0.84-2.00 µkat/L])
Magnesium = 2.0 mg/dL (1.5-2.3 mg/dL) (SI: 0.8 mmol/L [0.6-0.9 mmol/L])
Phosphate = 4.3 mg/dL (2.3-4.7 mg/dL) (SI: 1.4 mmol/L [0.7-1.5 mmol/L])
25-Hydroxyvitamin D = 25 ng/mL (30-80 ng/mL [optimal]) (62.4 nmol/L [74.9-199.7 nmol/L])
PTH = 12 pg/mL (10-65 pg/mL) (SI: 12 ng/L [10-65 ng/L])
Which of the following is the best treatment recommendation for this patient?

A. Discontinue alendronate and refer to orthopedic surgery
B. Discontinue alendronate and start teriparatide
C. Discontinue alendronate and change to an intravenous bisphosphonate
D. Continue alendronate
E. Continue alendronate and restart hormone therapy

Correct Answer: A

Learning objective:
Manage an atypical femur fracture associated with prolonged bisphosphonate use.
ITE 2019 Question 34

A 50-year-old woman presents to your office with concerns of hirsutism and male-pattern balding. She had normal menarche at age 12 years and regular menses with 2 uncomplicated pregnancies. Her periods stopped 1 year ago, and she has noticed increased facial hair in a beard-like distribution over the past 18 months, some male-pattern balding, and increased periareolar hair.

On physical examination, her BMI is 27 kg/m2 and blood pressure is 150/90 mm Hg. She is very muscular. She has terminal hairs on her chin in a full-beard distribution, 15 hairs on her areolae, and hair above and below the umbilicus. Her clitoris measures 2.8 x 1.7 cm. There are no striae.

Laboratory test results:

- LDL cholesterol = 151 mg/dL (<100 mg/dL [optimal]) (SI: 3.91 mmol/L [<2.59 mmol/L])
- Testosterone = 350 ng/dL (8-60 ng/dL) (SI: 12.1 nmol/L [0.3-2.1 nmol/L])
- DHEA-S = 120 µg/dL (15-200 µg/dL) (SI: 3.3 µmol/L [0.41-5.42 µmol/L])
- Prolactin = 15 ng/mL (4-30 ng/mL) (SI: 0.65 nmol/L [0.17-1.30 nmol/L])
- FSH = 19 mIU/mL (>30 mIU/mL [postmenopausal]) (SI: 19 IU/L [>30 IU/L])
- LH = 18 mIU/mL (>30 mIU/mL [postmenopausal]) (SI: 18 IU/L [>30 IU/L])
- Hemoglobin A1c = 5.8% (4.0%-5.6%) (40 mmol/mol [20-38 mmol/mol])
Which of the following is the best next test to evaluate this patient?

A. Transvaginal ultrasonography
B. Dexamethasone suppression test
C. Pituitary MRI
D. Ovarian venous sampling
E. Fasting glucose and C-peptide

Correct Answer: A

Learning objective:
Evaluate postmenopausal hyperandrogenism.
ITE 2019 Question 35

A 21-year-old woman with a 3-year history of type 1 diabetes mellitus returns for follow-up during her summer break from college. She is using multiple-daily injections of insulin with mealtime dosing based on her carbohydrate intake, and she measures her blood glucose 3 to 4 times daily. A physician near her university monitors her closely during the school year, and the patient reports overall reasonable glycemic control without clinically significant hypoglycemia. She has had no recent changes in her weight or energy level and has regular menses. She does not smoke cigarettes. She has seen an ophthalmologist for comprehensive dilated eye examinations on 2 occasions, with no evidence of retinopathy found during her appointment 1 year ago.

On physical examination, her blood pressure is 116/72 mm Hg and pulse rate is 68 beats/min. Her height is 67 in (170.2 cm), and weight is 136 lb (61.8 kg) (BMI = 21.3 kg/m²).

Laboratory data obtained at last year’s visit to your office include:

- Hemoglobin $A_{1c} = 6.8\% (4.0\%-5.6\%) (51\ mmol/mol [20-38\ mmol/mol])$
- Creatinine = 0.8 mg/dL (0.6-1.1 mg/dL) (SI: 70.7 µmol/L [53.0-97.2 µmol/L])
- Estimated glomerular filtration rate = 91 mL/min per 1.73 m² (>60 mL/min per 1.73 m²)
- TSH = 1.4 mIU/L (0.5-5.0 mIU/L)

You plan to perform a routine physical examination and to reassess her overall glycemic control with hemoglobin $A_{1c}$ testing.
Which of the following is also indicated now?

A. Screening for distal polyneuropathy using a 10-g monofilament and 128-Hz tuning fork
B. Measurement of the urinary albumin-to-creatinine ratio
C. Repeated comprehensive dilated eye examination
D. Performance of baseline resting electrocardiography
E. Measurement of fasting lipid profile

Correct Answer: E

Learning objective:
Use current recommendations to implement appropriate screening in patients with type 1 diabetes mellitus.
ITE 2019 Question 36

A 32-year-old woman comes in for evaluation of secondary amenorrhea. She underwent menarche at age 14 years and previously had normal menstrual cycles. She has 2 children aged 4 and 2 years, but has not had a period since she stopped breastfeeding her youngest child 1 year ago. She has not resumed using contraception since her periods had not yet returned but does not desire more children. She has a history of mild-moderate depression, but currently takes no regular medication.

On physical examination, she appears well with normal secondary sexual characteristics and normal breast exam with no evidence of galactorrhea. Her height is 68.5 in (174 cm), and weight is 150 lb (68.2 kg) (BMI = 22.5 kg/m²). Her blood pressure is 118/78 mm Hg.

Laboratory test results:

Prolactin = 95 ng/mL (4-30 ng/mL) (SI: 4.1 nmol/L [0.17-1.30 nmol/L])
LH = 2.0 mIU/mL (1.0-18.0 mIU/mL [follicular]; 20.0-80.0 mIU/mL [midcycle]; 0.5-18.0 mIU/mL [luteal]) (SI: 2.0 IU/L [1.0-18.0 IU/L (follicular); 20.0-80.0 IU/L (midcycle); 0.5-18.0 IU/L (luteal)])
FSH = 1.8 mIU/mL (2.0-12.0 mIU/mL [follicular]; 4.0-36.0 mIU/mL [midcycle]; 1.0-9.0 mIU/mL [luteal]) (SI: 1.8 IU/L [2.0-12.0 IU/L (follicular); 4.0-36.0 IU/L (midcycle); 1.0-9.0 IU/L (luteal)])
Estradiol = 25 pg/mL (10-180 pg/mL [follicular]; 100-300 pg/mL [midcycle]; 40-200 pg/mL [luteal]) (SI: 91.8 pmol/L [36.7-660.8 pmol/L (follicular); 367.1-1101.3 pmol/L (midcycle); 146.8-734.2 pmol/L (luteal)])

Pituitary-directed MRI shows a 4-mm, low-attenuation lesion consistent with an adenoma.
Which of the following pharmacotherapies would be the best treatment strategy for this patient?

A. Combined oral contraceptive pill
B. Bromocriptine
C. Cabergoline
D. Cabergoline and oral contraceptive pill
E. No treatment required

Correct Answer: A

Learning objective:
Recommend the oral contraceptive pill as an acceptable treatment of amenorrhea caused by microprolactinoma when fertility is not desired.
A 59-year-old woman is referred for evaluation of possible Cushing syndrome after bilateral adrenal nodules were found incidentally 6 months earlier. She has gained 150 lb (68.2 kg) over the past 15 years and has developed hypertension, type 2 diabetes mellitus, hyperlipidemia, sleep apnea, and depression. She has progressive weakness and relies on a wheelchair.

On physical examination, she is a morbidly obese woman. Her blood pressure is 135/82 mm Hg. Her height is 67 in (170.2 cm), and weight is 359 lb (163.2 kg) (BMI = 56.2 kg/m²). She has facial rounding, plethora, acanthosis nigricans on her neck, multiple skin tags, and a marked increase in supraclavicular fullness and dorsocervical fat accumulation. Cutaneous wasting is present with multiple ecchymoses on her arms and hands. She has 2+ pretibial edema and proximal muscle weakness.
Laboratory test results:

Electrolytes, normal

Complete blood cell count, normal

Hemoglobin A1c = 8.3% (4.0%-5.6%) (67 mmol/mol [20-38 mmol/mol])

Aldosterone = 4.4 ng/dL (4-21 ng/dL) (SI: 122.1 pmol/L [111.0-582.5 pmol/L])

Plasma renin activity = 9.1 ng/mL per h (0.6-4.3 ng/mL per h)

Urinary free cortisol (2 measurements) = 31 µg/24 h (4-50 µg/24 h) (SI: 85.6 nmol/d [11-138 nmol/d]) (second measurement: 41 µg/24 h [SI: 113.2 nmol/d]). Creatinine measurements on each sample confirm these were both full 24 hour collections.

Late-night salivary cortisol (4 measurements): 0.43 µg/dL (<0.13 µg/dL) (SI: 11.9 nmol/L [<3.6 nmol/L]) (second, third, and fourth measurements: 0.17 µg/dL [SI: 4.69 nmol/L], 0.30 µg/dL [SI: 8.28 nmol/L], and 0.24 µg/dL [SI: 6.62 nmol/L])

Cortisol after overnight 1-mg dexamethasone suppression test = 8.3 µg/dL (SI: 229.0 nmol/L)

Basal plasma ACTH = 53 pg/mL (10-60 pg/mL) (SI: 11.7 pmol/L [2.2-13.2 pmol/L])
Pituitary MRI findings are normal. Abdominal CT performed 6 months earlier is reviewed. Bilateral adrenal nodules (8 Hounsfield units on the right side and 4 Hounsfield units on the left side) are identified (see image, arrows).
Which of the following diagnostic studies should you recommend next?

A. Bilateral adrenal venous sampling for cortisol and aldosterone
B. Measurement of plasma free fractionated metanephrines
C. Bilateral inferior petrosal sinus sampling for ACTH
D. Dexamethasone–corticotropin-releasing hormone test
E. CT-guided percutaneous biopsy of the right adrenal nodule

Correct Answer: C

Learning objective:
Recommend bilateral inferior petrosal sinus sampling for ACTH as the diagnostic test of choice in patients with ACTH-dependent hypercortisolism and a normal pituitary imaging study.
ITE 2019 Question 38

A 72-year-old man presents with a 6-month history of an enlarging neck swelling. He describes a feeling of choking at night and increasing dysphagia when eating solid foods. He has mild shortness of breath on exertion and reports “3-pillow” orthopnea. He has no symptoms of thyroid dysfunction, and his weight has remained stable over the last 12 months. He underwent quadruple-vessel bypass surgery for ischemic heart disease 11 months ago. His current medications are aspirin, lisinopril, and atorvastatin. There is no notable family history.

On physical examination, his trachea is deviated to the left, and his lung fields are clear. A right-sided goiter is visible in his neck, and palpation reveals a smooth, 4 x 5-cm, right-sided thyroid swelling that moves with swallowing. There is no palpable cervical lymphadenopathy. The Pemberton sign is negative, and there is no clinical evidence of retrosternal extension.
Laboratory test results:

- TSH = 3.7 mIU/L (0.5-5.0 mIU/L)
- Free T4 = 1.3 ng/dL (0.8-1.8 ng/dL) (SI: 16.7 pmol/L [10.30-23.17 pmol/L])

Thyroid ultrasonography indicates the presence of a right-sided, large (32 x 38 x 51 mm), well-defined, thin-walled, anechoic thyroid lesion with a minimal amount of isoechoic solid tissue causing a small degree of tracheal deviation. The nodule has regular margins, no microcalcifications, and no other suspicious features.
Which of the following is the most likely diagnosis?

A. Anaplastic thyroid cancer  
B. Differentiated thyroid malignancy with cystic degeneration  
C. Benign thyroid cyst  
D. Multinodular goiter  
E. Thyroglossal duct cyst

Correct Answer: C  
Learning objective: 
Identify ultrasound features of a large, benign thyroid cyst.
ITE 2019 Question 39

A 43-year-old woman makes an appointment to discuss weight-loss medications. Her BMI is 33 kg/m². She has a history of multiple deep vein thromboses treated with warfarin and a seizure disorder that is controlled on phenytoin.
Which of the following US FDA–approved weight-loss medications would be the best choice for this patient?

A. Orlistat, 120 mg 3 times daily  
B. Liraglutide, 3 mg daily  
C. Topiramate, titrated to 50 mg twice daily  
D. Naltrexone-bupropion, 8 mg/90 mg tablets titrated to 32 mg/360 mg daily

Correct Answer: B

Learning objective: 
List the contraindications for specific weight-loss medications.
A 58-year-old man with metastatic melanoma being treated medically is admitted to the hospital with lethargy, altered mental status, and hypotension. In addition to his anticancer therapy, he takes levothyroxine for hypothyroidism (Hashimoto thyroiditis was diagnosed many years ago).

Laboratory test results:

- Random cortisol = 2.1 μg/dL (5-25 μg/dL) (SI: 57.9 nmol/L [137.9-689.7 nmol/L])
- ACTH = <5 pg/mL (10-60 pg/mL) (SI: <1.1 pmol/L [2.2-13.2 pmol/L])
- Testosterone = 21 ng/dL (300-900 ng/dL) (SI: 0.7 nmol/L [10.4-31.2 nmol/L])
- LH = 0.4 mIU/mL (1.0-9.0 mIU/mL) (SI: 0.4 IU/L [1.0-9.0 IU/L])
- FSH = 2.1 mIU/mL (1.0-13.0 mIU/mL) (SI: 2.1 IU/L [1.0-13.0 IU/L])
- IGF-1 = 45 ng/mL (78-220 ng/mL) (SI: 5.9 nmol/L [10.2-28.8 nmol/L])
- Prolactin = 1.3 ng/mL (4-23 ng/mL) (SI: 0.06 nmol/L [0.17-1.00 nmol/L])
- TSH = 0.3 mIU/L (0.5-5.0 mIU/L)

MRI shows homogeneous enlargement of the pituitary gland and stalk, which was not present on MRI 2 months ago.
Which of the following medications is the most likely cause of this patient’s pituitary abnormalities?

A. Prednisone  
B. Ipilimumab  
C. Temozolomide  
D. Sunitinib

Correct Answer: B

Learning objective:
Identify medications that can cause hypophysitis.
ITE 2019 Question 41

A 70-year-old woman is referred for management of osteoporosis. She sustained a vertebral fracture 5 years ago, which prompted DXA imaging that showed osteoporosis in the lumbar spine (T-score –3.0). After an appropriate workup for secondary causes of osteoporosis, which was normal, she was prescribed risedronate, 150 mg monthly, which she did not tolerate because of severe gastroesophageal reflux. She was then switched to denosumab, 60 mg twice yearly. Follow-up DXA studies show improvement in lumbar spine bone mineral density, such that her lumbar spine T-score is now in the osteopenic range (T-score, –1.9). However, she has developed significant erythema with pruritis at the injection site following the last 2 injections. The most recent reaction was worse than the prior one and she returns to discuss the best approach to her osteoporosis management.

She has rate-controlled atrial fibrillation but is otherwise healthy. She has no active dental concerns. Denosumab and a β-adrenergic blocker are her only current medications.
Current laboratory test results:

- Creatinine = 0.8 mg/dL (0.6-1.1 mg/dL) (SI: 70.7 µmol/L [53.0-97.2 µmol/L])
- Calcium adjusted for albumin = 9.5 mg/dL (8.2-10.2 mg/dL) (SI: 2.4 mmol/L [2.1-2.6 mmol/L])
- 25-Hydroxyvitamin D = 45 ng/mL (30-80 ng/mL [optimal]) (SI: 112.3 nmol/L [74.9-199.7 nmol/L])

The rest of her relevant chemistry and hematology profiles are unremarkable.
Which of the following is the most appropriate recommendation regarding management of her osteoporosis now?

A. Continue denosumab twice yearly
B. Continue denosumab, but decrease the dosing to once yearly
C. Discontinue denosumab, but continue supplemental calcium and vitamin D
D. Discontinue denosumab and start raloxifene
E. Discontinue denosumab and start zoledronic acid once yearly

Correct Answer: E

Learning objective:

In a postmenopausal woman with osteoporosis, determine the need to start zoledronic acid based on the risk-benefit assessment upon discontinuation of denosumab.
A 51-year-old man presents with decreased libido and erectile dysfunction and is found to have the following laboratory values:

Testosterone = 197 ng/mL (300-900 ng/dL) (SI: 6.8 nmol/L [0.31-1.04 nmol/L])
Prolactin = 39 ng/mL (4-23 ng/mL) (SI: 1.7 nmol/L [0.17-1.00 nmol/L])

A 14-mm pituitary adenoma is identified on MRI. While taking cabergoline, 0.5 mg twice weekly, his prolactin and testosterone levels normalize and his libido and erectile function improve. Two years later, he develops headaches and erectile dysfunction again despite maintaining a normal prolactin level on cabergoline therapy.
Which of the following should be the next management step?

A. Discontinue cabergoline
B. Switch cabergoline to bromocriptine
C. Increase the cabergoline dosage to 1.0 mg twice weekly
D. Perform another pituitary-directed MRI

Correct Answer: D

Learning objective:
Distinguish prolactinomas from clinically nonfunctioning adenomas.
A 36-year-old man is referred for evaluation of an abnormal left humerus x-ray. He describes a 2- to 3-year history of constant aching in his left mid-upper arm that has gradually worsened over time. He recalls no antecedent trauma. He has no history of fractures. He describes frequent headaches involving both parietal regions, which are poorly responsive to ibuprofen. He takes no medications or supplements. The rest of his medical history and accompanying family history are unremarkable. Review of systems is notable for an unintentional 10-lb (4.5-kg) weight loss.

On physical examination, he has mild, diffuse tenderness over the left mid-humerus without an apparent mass or deformity. There is a hyperpigmented, macular lesion with irregular borders over his upper back and neck that extends from the midline laterally. The thyroid is palpably enlarged and nodular without a dominant lesion. Deep tendon reflexes are brisk with a shortened recovery phase. The rest of his examination findings, including exam of the cranium, are normal.

Results from complete blood cell count, creatinine, AST, ALT, total bilirubin, calcium, phosphate, intact PTH, and 25-hydroxyvitamin D are normal. Abnormalities identified on laboratory workup:

- TSH = 0.03 mIU/L (0.5-5.0 mIU/L)
- Free T4 = 2.5 ng/dL (0.8-1.8 ng/dL) (SI: 32.2 ng/dL [10.30-23.17 pmol/L])
- Alkaline phosphatase = 310 U/L (50-120 U/L) (SI: 5.18 µkat/L [0.84-2.00 µkat/L])
Anteroposterior radiograph of the left humerus is shown (see image).
Which of the following is the most likely diagnosis in this patient?

A. Celiac disease
B. Fibrous dysplasia
C. Graves disease
D. Paget disease of bone
E. Tumor-induced osteomalacia

Correct Answer: B

Learning objective:
Diagnose McCune-Albright syndrome and fibrous dysplasia.
A 61-year-old man undergoes right adrenalectomy, right nephrectomy, and partial hepatectomy for adrenocortical carcinoma. Eight months earlier, he was discovered to have a 16-cm right adrenal mass with evidence of liver and pulmonary metastases. He had no clinical evidence of Cushing syndrome, although no steroid profile was obtained. He was referred to an oncologist. The patient received 6 cycles of adriamycin, cisplatin, and etoposide. Mitotane was also prescribed, and he has taken 3 to 6 g daily since his diagnosis and this has resulted in therapeutic mitotane levels. The adrenal mass regressed to 12 cm, his pulmonary metastases were no longer visible, and his liver metastases were stable.

Eight hours after surgery, he develops shock with a blood pressure of 60/30 mm Hg, a pulse rate of 118 beats/min, and a temperature of 104°F (40°C). He is intubated after a bolus of etomidate, 10 mg intravenously, and mechanical ventilation is started. Urine output diminishes to less than 20 mL/h. Aggressive fluid resuscitation with isotonic fluids is initiated along with vasopressors (dopamine and norepinephrine infusion).

A rapid ACTH-stimulation test is performed and then hydrocortisone, 100 mg intravenously every 8 hours, is immediately initiated.
Which of the following patterns of laboratory test results would you most likely expect from the rapid ACTH-stimulation test in this patient?

<table>
<thead>
<tr>
<th>Answer</th>
<th>Basal ACTH</th>
<th>Basal Cortisol</th>
<th>+30 min Cortisol</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>&lt;5 pg/mL (&lt;1.1 pmol/L)</td>
<td>4.3 µg/dL (188.6 nmol/L)</td>
<td>15.0 µg/dL (413.8 nmol/L)</td>
</tr>
<tr>
<td>B.</td>
<td>765 pg/mL (168.3 pmol/L)</td>
<td>4.2 µg/dL (115.9 nmol/L)</td>
<td>4.3 µg/dL (118.6 nmol/L)</td>
</tr>
<tr>
<td>C.</td>
<td>365 pg/mL (80.3 pmol/L)</td>
<td>4.2 µg/dL (115.9 nmol/L)</td>
<td>15.0 µg/dL (413.8 nmol/L)</td>
</tr>
<tr>
<td>D.</td>
<td>&lt;5 pg/mL (&lt;1.1 pmol/L)</td>
<td>42.0 µg/dL (1158.7 nmol/L)</td>
<td>45.0 µg/dL (1241.5 nmol/L)</td>
</tr>
<tr>
<td>E.</td>
<td>23 pg/mL (5.1 pmol/L)</td>
<td>18.0 µg/dL (496.6 nmol/L)</td>
<td>45.0 µg/dL (1241.5 nmol/L)</td>
</tr>
</tbody>
</table>

Correct Answer: B. B

Learning objective:
Predict the pattern of laboratory test results in a patient with mitotane-induced primary adrenal insufficiency.
ITE 2019 Question 45

A 76-year-old woman returns for follow-up of diabetes mellitus. She describes persistent tingling in her feet and legs over the last 4 months. These sensations are distinct from symptoms of numbness in the feet that she has had for the last several years. She also notes unsteadiness, with several near falls when she gets up at night. She describes eating a well-balanced diet with all food groups represented. During her 13-year history of type 2 diabetes, she has been treated with metformin and glipizide.

On physical examination, her blood pressure is 126/74 mm Hg and BMI is 28 kg/m2. Cranial nerves II through XII are intact. There is evidence of muscle atrophy of the distal lower extremities with loss of pinprick sensation to the mid shin, decreased vibratory sense in the great toes, and loss of patellar and Achilles reflexes. The Romberg test is positive and the Babinski sign is present.

Laboratory test results:

- Hemoglobin A1c = 7.3% (4.0%-5.6%) (56 mmol/mol [20-38 mmol/mol])
- Hemoglobin = 10.7 g/dL (12.1-15.1 g/dL) (SI: 107 g/L [121-151 g/L])
- Hematocrit = 35% (35%-45%) (SI: 0.35 [0.35-0.45])
- Creatinine = 1.5 mg/dL (0.6-1.1 mg/dL) (SI: 132.6 µmol/L [53.0-97.2 µmol/L])
- AST = 55 U/L (20-48 U/L) (SI: 0.92 µkat/L [0.33-0.80 µkat/L])
- ALT = 72 U/L (10-40 U/L) (SI: 1.20 µkat/L [0.17-0.67 µkat/L])
- Urinalysis, positive for leukocyte esterase and protein
Which of the following is the best next step in this patient’s management?

A. Measurement of serum vitamin $B_{12}$
B. Measurement of serum vitamin $B_1$
C. MRI of the lumbar spine
D. Electromyelography and nerve conduction studies
E. Myelography

Correct Answer: A

Learning objective:
Diagnose and manage adverse effects of metformin.
A 42-year-old woman with polycystic ovary syndrome presents for follow-up. At the time of diagnosis, laboratory evaluation documented normal TSH, prolactin, FSH, and urinary free cortisol values. She was treated with an oral contraceptive pill, which she stopped 1 year ago. Since then, she has noted worsening hirsutism and acne, has had no menses, and has gained 22 lb (10 kg).

On physical examination, her blood pressure is 130/80 mm Hg. Her height is 67 in (170.2 cm), and weight is 260 lb (118.2 kg) (BMI = 40.7 kg/m2). Cystic acne is present on her back. Her Ferriman-Gallwey score is 10, and acanthosis nigricans is present on her neck, in the axillae and groin, and on her knuckles. Pelvic examination reveals a normal uterus and ovaries, but is limited by obesity.

Laboratory test results:

- Testosterone = 89 ng/dL (8-60 ng/dL) (SI: 3.1 nmol/L [0.3-2.1 nmol/L])
- DHEA-S = 122 µg/dL (18-244 µg/dL) (SI: 3.3 µmol/L [1.19-9.00 µmol/L])
- Hemoglobin A1c = 7.5% (4.0%-5.6%) (58 mmol/mol [20-38 mmol/mol])
- β-hCG = <3.0 mIU/mL (<3.0 mIU/mL) (SI: <3.0 IU/L [<3.0 IU/L])
Pelvic ultrasonography reveals an endometrial stripe with a cystic appearance and a thickness of 10 mm (see image).

She is given a course of medroxyprogesterone, 10 mg daily for 10 days, which does not trigger a withdrawal bleed.
Which of the following assessments should you order next?

A. Another pelvic ultrasound in 2 weeks
B. FSH measurement
C. Papanicolaou test
D. Medroxyprogesterone challenge at a higher dose
E. Endometrial biopsy

Correct Answer: E

Learning objective:
ORDER THE APPROPRIATE EVALUATION FOR AN OBESE WOMAN WITH POLYCYSTIC OVARY SYNDROME WHO PRESENTS WITH LONGSTANDING AMENORRHEA IN THE ABSENCE OF TREATMENT.
A 28-year-old woman is referred for evaluation of a pituitary adenoma that was incidentally discovered on cranial MRI performed to investigate headache. She reports no change in appearance or weight. Her menstrual cycles are regular (last menstrual period was 2 weeks ago), and she is currently sexually active. She wishes to become pregnant as soon as possible.

On physical examination, she has no obvious features of GH or cortisol excess. Her height is 62 in (157.5 cm), and weight is 123 lb (56 kg) (BMI = 22.5 kg/m²). Her blood pressure is 118/69 mm Hg.

Laboratory test results:

- TSH = 1.8 mIU/L (0.5-5.0 mIU/L)
- Free T4 = 1.1 ng/dL (0.8-1.8 ng/dL) (SI: 14.2 pmol/L [10.30-23.17 pmol/L])
- Cortisol (8 AM) = 18 μg/dL (5-25 μg/dL) (SI: 496.6 nmol/L [137.9-689.7 nmol/L])
- Estradiol = 315 pg/mL (10-180 pg/mL [follicular]) (SI: 1156.4 pmol/L [36.7-660.8 pmol/L])
- IGF-1 = 168 ng/mL (117-321 ng/mL) (SI: 22.0 nmol/L [15.3-42.1 nmol/L])
- Prolactin = 28 ng/mL (4-30 ng/mL) (SI: 1.22 nmol/L [0.17-1.30 nmol/L])
MRI shows a 9-mm, low-attenuation lesion in the center and right side of the pituitary gland (coronal image on the left and sagittal image on the right). It elevates the pituitary gland overlying it, abutting and minimally compressing the left side of the optic chiasm and deviating the pituitary stalk to the left. Findings on visual field assessment are normal.
Which of the following is the best management option?

A. Refer for consideration of pituitary surgery
B. Commence cabergoline therapy
C. Commence octreotide therapy
D. Perform another pituitary-directed MRI in 2 years
E. Advise routine pituitary-directed MRI in the first trimester of pregnancy

Correct Answer: A

Learning objective:
Devise an appropriate follow-up plan of an incidentally discovered pituitary microadenoma and explain the impact of pregnancy on pituitary volume.
A 55-year-old man with progressive multiple myeloma undergoes laboratory testing before initiation of therapy with a novel experimental agent. Other than mild fatigue and achiness, he has no new or worrisome symptoms. Specifically, he has not experienced anorexia, nausea, vomiting, polyuria, polydipsia, or abdominal pain. On neurologic examination, he is alert and oriented without focal findings.

Laboratory test results (serum):

Calcium = 18.4 mg/dL (8.2-10.2 mg/dL) (SI: 4.6 mmol/L [2.1-2.6 mmol/L])
Albumin = 3.9 g/dL (3.5-5.0 g/dL) (SI: 39 g/L [35-50 g/L])
Phosphate = 4.0 mg/dL (2.3-4.7 mg/dL) (SI: 1.3 mmol/L [0.7-1.5 mmol/L])
Creatinine = 1.0 mg/dL (0.7-1.3 mg/dL) (SI: 88.4 µmol/L [61.9-114.9 µmol/L])
Intact PTH = 34 pg/mL (10-65 pg/mL) (SI: 34 ng/L [10-65 ng/L])
Which of the following should you do now?

A. Refer for emergent parathyroid exploration
B. Measure serum ionized calcium
C. Begin cinacalcet, 30 mg orally 3 times daily
D. Refer for emergent plasmapheresis
E. Administer zoledronic acid, 5 mg intravenously

Correct Answer: B

Learning objective:
Diagnose “pseudohypercalcemia” and recommend measurement of ionized calcium in certain cases of multiple myeloma.
A 52-year-old woman recently completed a successful course of pegylated-interferon-α and ribavirin therapy for chronic hepatitis C virus infection. Approximately 1 month after this treatment was completed, she presented to the emergency department with weight loss, fatigue, polydipsia, and polyuria. Diabetic ketoacidosis was diagnosed. She was admitted to the hospital and with appropriate management the ketoacidosis has quickly resolved. Over the past 10 hours, her glycemic control has been excellent on insulin infusion at a rate of 0.5 units per hour, and no adjustments to her insulin infusion rate have been required. The patient will begin eating solid food later this morning. Her renal function and serum electrolytes are now within normal limits.

The patient has no personal or family history of diabetes. Laboratory testing for glutamic acid decarboxylase autoantibodies was negative when performed at the start of her course of antiviral therapy. She tolerated that therapy well, had an excellent response in her viral load, and was without evidence of hyperglycemia during treatment.

The patient is afebrile and has normal physical examination findings. Her height is 66 in (167.6 cm), and weight is 160 lb (72.7 kg) (BMI = 25.8 kg/m2).
Which of the following is the best management plan for this patient?

A. Transition from intravenous insulin infusion to a scheduled subcutaneous basal-bolus insulin regimen
B. Transition from intravenous insulin infusion to twice-daily metformin therapy
C. Discontinue all intravenous insulin infusion and continue to monitor blood glucose values
D. Begin high-dosage glucocorticoid therapy and continue the intravenous insulin infusion
E. Transition from intravenous insulin to sulfonylurea therapy

Correct Answer: A

Learning objective:
Manage new-onset diabetes in a patient with interferon-treated hepatitis C infection.
A 32-year-old pregnant woman with a history of acromegaly comes for a visit at 18 weeks’ gestation. She was treated by debulking pituitary surgery 3 years ago, but a small tumor remnant remained in the cavernous sinus. As a result, IGF-1 and GH levels failed to normalize after surgery and she required management with intramuscular lanreotide with the subsequent addition of pegvisomant. She feels well and has no concerns.

On physical examination, she has mild acromegalic facies. Her blood pressure is 112/78 mm Hg, and pulse rate is 100 beats/min. Visual fields are normal.

Laboratory test results 2 months before pregnancy:

- GH = 1.8 ng/mL (0.01-3.61 ng/mL) (SI: 1.8 µg/L [0.01-3.61 µg/L])
- IGF-1 = 195 ng/mL (113-297 ng/mL) (SI: 25.5 µg/L [14.8-38.9 µg/L])
- Prolactin = 19 ng/mL (4-30 ng/mL) (SI: 0.83 µg/L [0.17-1.30 µg/L])

Current laboratory test results:

- GH = 4.0 ng/mL (SI: 4.0 µg/L)
- IGF-1 = 320 ng/mL (SI: 41.9 µg/L)
- Prolactin = 220 ng/mL (SI: 9.6 µg/L)
Pituitary-directed MRI is shown (see image). Residual tumor is visible in the left side of the pituitary (white arrow), extending into cavernous sinus (stable compared with MRI 1 year ago).
Which of the following should you recommend as the best next management step for this patient?

A. Continue current therapy
B. Stop pegvisomant and continue lanreotide
C. Stop pegvisomant and lanreotide; start cabergoline
D. Stop current therapy; restart if IGF-1 continues to rise
E. Stop current therapy; do not routinely monitor IGF-1 during pregnancy

Correct Answer: E

Learning objective:
Manage acromegaly during pregnancy and counsel patients about the difficulty of monitoring GH status in this setting.
ITE 2019 Question 51

An 82-year-old woman has been referred to evaluate a neck swelling that has been present for at least 30 years. The size of the swelling has gradually increased. The patient reports the recent development of difficulty swallowing, mostly solid food, as well as a feeling of choking, especially when lying flat. She also reports increasing shortness of breath, most notably when climbing stairs. There is no notable family history.

On physical examination, she has a multinodular goiter that is visible in an erect position with neck extension. A dominant left-sided thyroid nodule is palpable that measures 7 x 5 cm. The lower lobe of the thyroid gland extends below the sternal notch and cannot be palpated when the patient is lying in the supine position with mild neck extension or with swallowing. The Pemberton sign is negative. There is tracheal deviation to the right, but no audible stridor and lung fields are clear.

Laboratory test results:

- Serum TSH = 4.7 mIU/L (0.5-5.0 mIU/L)
- Serum free T4 = 1.1 ng/dL (0.8-1.8 ng/dL) (SI: 14.2 pmol/L [10.30-23.17 pmol/L])
Which of the following is the most appropriate assessment to decide if surgery is warranted to alleviate compressive symptoms?

A. Noncontrast CT of the neck and chest  
B. Barium swallow  
C. Flow-volume loop  
D. Thyroid ultrasonography and FNA biopsy of the left-sided nodule  
E. 18-Fluorodeoxyglucose PET-CT

Correct Answer: A

Learning objective:
Diagnose large, nontoxic multinodular goiter.
ITE 2019 Question 52

A 22-year-old woman with type 1 diabetes mellitus is 7 weeks pregnant. Her most recent hemoglobin A1c value is 6.9% (52 mmol/mol). She is taking insulin detemir, 8 units in the morning and 12 units in the evening, in addition to prandial doses of insulin lispro based on an insulin-to-carbohydrate ratio of 1:10 and a sensitivity (or correction) factor of 1:40. Her overnight (3 AM) and fasting blood glucose levels range between 110 and 122 mg/dL (6.1-6.8 mmol/L), and her peak (1-hour) postprandial glucose levels range between 112 and 129 mg/dL (6.2-7.2 mmol/L).
Which of the following should you recommend during this pregnancy?

A. Continue same regimen
B. Change her insulin-to-carbohydrate ratio to 1:8
C. Increase morning insulin detemir dose to 12 units
D. Increase evening insulin detemir dose to 14 units
E. Change her sensitivity (or correction) factor to 1:30

Correct Answer: D
Learning objective:
Make basic recommendations for management of glycemia during pregnancy.
ITE 2019 Question 53

A 68-year-old man with refractory atrial fibrillation is prescribed amiodarone. Baseline thyroid function is normal. One month later, the patient is asymptomatic, but is noted to have the following laboratory findings:

- Total T<sub>4</sub> = 13.4 μg/dL (5.5-12.5 μg/dL) (SI: 172.5 nmol/L [94.02-213.68 nmol/L])
- Free T<sub>4</sub> = 1.91 ng/dL (0.8-1.8 ng/dL) (SI: 24.6 pmol/L [10.30-23.17 pmol/L])
- Total T<sub>3</sub> = 65 ng/dL (70-200 ng/dL) (SI: 1.0 nmol/L [1.08-3.08 nmol/L])
- TSH = 3.9 mIU/L (0.5-5.0 mIU/L)
Which of the following is the most likely explanation for these findings?

A. Type 1 amiodarone-induced thyrotoxicosis  
B. Type 2 amiodarone-induced thyrotoxicosis  
C. Expected changes in euthyroid patients on amiodarone  
D. Assay interference by amiodarone metabolites  
E. Euthyroid sick syndrome

Correct Answer: C  
Learning objective:  
Distinguish expected changes in thyroid function parameters in patients taking amiodarone from amiodarone-induced thyroid dysfunction.
ITE 2019 Question 54

A 27-year-old woman with a history of hypertriglyceridemia and pancreatitis has controlled her hypertriglyceridemia reasonably well with diet and fenofibrate. Her triglyceride levels on this program have ranged from 595 to 880 mg/dL (6.72-9.94 mmol/L). She has 2 children, aged 4 and 7 years, and she developed gestational diabetes during her last pregnancy. She was not prescribed oral contraceptive pills because of her hypertriglyceridemia. She now returns 8 months after her last visit and reports that she is 12 weeks pregnant and still taking fenofibrate.

Laboratory test results:

- Total cholesterol = 300 mg/dL (<200 mg/dL [optimal]) (SI: 7.77 mmol/L [<5.18 mmol/L])
- Triglycerides = 815 mg/dL (<150 mg/dL [optimal]) (SI: 9.21 mmol/L [<1.70 mmol/L])
- HDL cholesterol = 31 mg/dL (>60 mg/dL [optimal]) (SI: 0.80 mmol/L [>1.55 mmol/L])
- Fasting glucose = 105 mg/dL (70-99 mg/dL) (SI: 5.8 mmol/L [3.9-5.5 mmol/L])
- Hemoglobin A1c = 7.0% (4.0%-5.6%) (53 mmol/mol [20-38 mmol/mol])
Which of the following is the most reasonable strategy now?

A. Continue fenofibrate
B. Substitute atorvastatin for fenofibrate
C. Substitute nicotinic acid for fenofibrate
D. Substitute omega-3 fatty acids for fenofibrate

Correct Answer: A

Learning objective:
Develop an approach to treating severe hypertriglyceridemia during pregnancy.
A 58-year-old man with hypertension, hyperlipidemia, and obesity presents for follow-up. Ten months ago, he was documented to have 2 low testosterone measurements when he sought evaluation for symptoms of fatigue, poor sleep, worsening erectile function, and mild lower urinary symptoms. Secondary hypogonadism was diagnosed, and he was prescribed a topical testosterone gel. While on the testosterone therapy, he noticed a modest increase in his energy but a mild worsening of his urinary symptoms. He had only modest improvement in erectile function, so a phosphodiesterase inhibitor was added. He also takes atorvastatin and lisinopril.

On physical examination, his height is 67 in (170 cm) and weight is 210 lb (95.5 kg) (BMI = 32.9 kg/m2). His blood pressure is 144/87 mm Hg, and pulse rate is 71 beats/min. Examination findings are normal. Testicular volume is 12 to 15 mL bilaterally.
Laboratory test results:

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Baseline</th>
<th>10 Months on Testosterone</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total testosterone</strong></td>
<td>238 and 261 ng/dL (SI: 8.3 and 9.1 nmol/L)</td>
<td>672 ng/dL (SI: 23.3 nmol/L)</td>
</tr>
<tr>
<td>(300-900 ng/dL [SI: 10.4-31.2 nmol/L])</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PSA</strong></td>
<td>1.2 ng/mL (SI: 1.2 µg/L)</td>
<td>2.9 ng/mL (SI: 2.9 µg/L)</td>
</tr>
<tr>
<td>(&lt;3.8 ng/mL [&lt;3.8 µg/L])</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hematocrit</strong></td>
<td>47% (0.47)</td>
<td>51% (0.51)</td>
</tr>
<tr>
<td>(41%-50% [0.41-0.50])</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Chemistry panel</strong></td>
<td>Normal</td>
<td>Normal</td>
</tr>
<tr>
<td><strong>DXA scan</strong></td>
<td>Hip T-score, –1.2</td>
<td>Hip T-score, –1.2</td>
</tr>
<tr>
<td></td>
<td>Spine T-score, –1.0</td>
<td>Spine T-score, –1.1</td>
</tr>
</tbody>
</table>
Which of the following is the best next step in this patient’s management?

A. Continue testosterone therapy at the current dosage
B. Decrease the testosterone dosage due to elevated hematocrit
C. Decrease the testosterone dosage to target testosterone <500 ng/dL (<17.4 nmol/L) given his age
D. Increase the testosterone dosage due to lack of increase in T-scores
E. Refer for urologic evaluation due to increase in PSA

Correct Answer: E

Learning objective:
In a patient on testosterone therapy, determine when a rise in prostate-specific antigen should prompt urologic evaluation.
A 23-year-old woman in her 12th week of pregnancy is found to have a 1.9-cm thyroid nodule. She has no associated adenopathy in the neck.

Laboratory test results:

- Serum TSH = 0.1 mIU/L
- Free $T_4$ = 1.2 ng/dL (0.8-1.8 ng/dL) (SI: 15.4 pmol/L [10.30-23.17 pmol/L])

Thyroid ultrasonography shows intranodular vascularity, but no other suspicious findings.
Which of the following should be the next step in this patient’s management?

A. Fine-needle aspiration biopsy
B. Technetium thyroid scan
C. Thyroid lobectomy
D. Initiation of methimazole
E. Initiation of propylthiouracil

Correct Answer: A

Learning objective:
Recommend fine-needle aspiration biopsy of a suspicious nodule despite mildly low TSH in the first trimester of pregnancy.
A 21-year-old woman presents for evaluation of secondary amenorrhea. Menarche occurred at age 13 years. Menses were regular until age 15 when they stopped for a year. Her pediatrician thought it was due to low body fat percentage from running cross-country, and he prescribed oral contraceptives. She had regular withdrawal bleeds on the pill, but stopped treatment on her own 6 months ago and has had no periods since. Micronized progesterone (for 10 days) was prescribed on 2 separate occasions; she had no withdrawal bleeding with the initial lower dose, but did have withdrawal bleeding after the higher dose.

The patient has no hot flashes, vaginal dryness, or galactorrhea. She runs 2 to 4 miles 3 to 5 times a week. There is no history of eating disorders. She has never been pregnant and has never had a pelvic infection or gynecologic procedure.

On physical examination, her blood pressure is 110/74 mm Hg. Her height is 65 in (165 cm), and weight is 115 lb (52.3 kg) (BMI = 19.1 kg/m²). She has no terminal hair growth or acne. The rest of her examination findings are unremarkable.
Recent laboratory test results:

- TSH = 2.3 mIU/L (0.5-5.0 mIU/L)
- Prolactin = 12 ng/mL (4-30 ng/mL) (SI: 0.17-1.30 nmol/L)
- LH = 13.0 mIU/mL (1.0-18.0 mIU/mL [follicular]; 20.0-80.0 mIU/mL [midcycle]; 0.5-18.0 mIU/mL [luteal]; >30 mIU/mL [postmenopausal]) (SI: 13.0 IU/L [<1.0 IU/L (prepubertal); 1.0-18.0 IU/L (follicular); 20.0-80.0 IU/L (midcycle); 0.5-18.0 IU/L (luteal); >30 IU/L (postmenopausal)])
- FSH = 6.6 mIU/mL (2.0-12.0 mIU/mL [follicular]; 4.0-36.0 mIU/mL [midcycle]; 1.0-9.0 mIU/mL [luteal]; >30 mIU/mL [postmenopausal]) (SI: 6.6 IU/L [<3.0 IU/L (prepubertal); 2.0-12.0 IU/L (follicular); 4.0-36.0 IU/L (midcycle); 1.0-9.0 IU/L (luteal); >30 IU/L (postmenopausal)])
- Estradiol = 62 pg/mL (10-180 pg/mL [follicular]; 100-300 pg/mL [midcycle]; 40-200 pg/mL [luteal]; <20 pg/mL [postmenopausal]) (SI: 227.6 pmol/L [36.7-660.8 pmol/L (follicular); 367.1-1101.3 pmol/L (midcycle); 146.8-734.2 pmol/L (luteal); <73.4 pmol/L (postmenopausal)])
- Androstenedione = 322 ng/dL (80-240 ng/dL) (SI: 11.2 nmol/L [2.79-8.38 nmol/L])
- Cortisol (8 AM) = 12 µg/dL (5-25 µg/dL) (SI: 331.1 nmol/L [137.9-689.7 nmol/L])
- Antimullerian hormone = 10.0 ng/mL (0.9-9.5 ng/mL) (SI: 71.4 pmol/L [6.4-67.9 pmol/L])

Pelvic ultrasonography reveals an ovarian volume of 5 mL bilaterally with a uterine lining thickness of 6 mm.
Which of the following is the most likely diagnosis?

A. Premature ovarian insufficiency
B. Polycystic ovary syndrome
C. Functional hypothalamic amenorrhea
D. Empty sella syndrome
E. Asherman syndrome

Correct Answer: B

Learning objective:
Distinguish between polycystic ovary syndrome and hypothalamic amenorrhea in a woman with secondary amenorrhea.
ITE 2019 Question 58

A 41-year-old woman with a 33-year history of type 1 diabetes mellitus complicated by end-stage kidney disease, proliferative retinopathy, and peripheral neuropathy underwent kidney-pancreas transplant 17 months ago due to severe hypoglycemia with unawareness.

Since surgery, she has been treated with prednisone and the dosage was tapered to 5 mg daily 6 months after the transplant. She has been off insulin since 7 days after transplant. Her hemoglobin A1c level was 6.0% (42 mmol/mol) 6 months after transplant and 6.3% (45 mmol/mol) 12 months after transplant.

Her medications include prednisone, tacrolimus, mycophenolate pregabalin, fosinopril, metoprolol, fluoxetine, and atorvastatin.

On physical examination, her height is 67 in (170 cm) and weight is 153 lb (69.5 kg) (BMI = 24.0 kg/m2). Her blood pressure is 128/79 mm Hg, and pulse rate is 74 beats/min. On eye examination, laser scars are evident. She has reduced sensation to 10-g monofilament testing and reduced vibrational sense in each foot. The ankle and patellar reflexes are blunted.
Laboratory test results:

- Hemoglobin A\textsubscript{1c} = 7.3\% (4.0\%-5.6\%) (56 mmol/mol [20-38 mmol/mol])
- Fasting glucose = 139 mg/dL (<70-99 mg/dL) (SI: 7.7 mmol/L [3.9-5.5 mmol/L])
- C-peptide = 1.9 ng/mL (0.9-4.3 ng/mL) (SI: 0.63 nmol/L [0.30-1.42 nmol/L])
- Electrolytes, normal
- Creatinine = 1.5 mg/dL (0.6-1.1 mg/dL) (SI: 132.6 µmol/L [53.0-97.2 µmol/L])
- Estimated glomerular filtration rate = 53 mL/min per 1.73 m\textsuperscript{2} (>60 mL/min per 1.73 m\textsuperscript{2})
- Amylase = 56 U/L (26-102 U/L) (SI: 0.94 µkat/L [0.43-1.70 µkat/L])
Which of the following is the most likely explanation for her elevated fasting glucose and hemoglobin A$_{1c}$?

A. Pancreas rejection
B. Transient hyperglycemia after transplant
C. Posttransplant diabetes mellitus
D. Autoimmune $\beta$-cell destruction (recurrence of type 1 diabetes)

Correct Answer: C

Learning objective:
Diagnose posttransplant diabetes mellitus and summarize recommendations for appropriate treatment.
ITE 2019 Question 59

A 51-year-old man comes to see you for follow-up of type 2 diabetes mellitus. He takes no lipid-lowering medications. His fasting lipid panel reveals the following:

- LDL cholesterol = 98 mg/dL (<100 mg/dL [optimal]) (SI: 2.54 mmol/L [<2.59 mmol/L])
- HDL cholesterol = 38 mg/dL (>60 mg/dL [optimal]) (SI: 0.98 mmol/L [>1.55 mmol/L])
- Triglycerides = 290 mg/dL (<150 mg/dL [optimal]) (SI: 3.28 mmol/L [<1.70 mmol/L])
Which of the following would be the most appropriate medication(s) to start?

A. Gemfibrozil  
B. Rosuvastatin  
C. Omega-3 fatty acids  
D. Niacin  
E. Rosuvastatin plus fenofibrate

Correct Answer: B

Learning objective:
Recommend a treatment approach for moderate hypertriglyceridemia in patients with type 2 diabetes mellitus
A 67-year-old woman with a 13-year history of type 2 diabetes mellitus, as well as hypertension, hyperlipidemia, and osteoporosis, presents for follow-up. She has no known diabetes-related complications. Her current medications are metformin, 1000 mg twice daily; lisinopril; atorvastatin; and alendronate. She does not smoke cigarettes, but does report drinking 1 to 2 glasses of red wine daily. Her mother has diabetes and osteoporosis, and her father has diabetes and coronary artery disease.

On physical examination, her height is 66 in (167.5 cm) and weight is 192 lb (82.5 kg) (BMI = 31.0 kg/m^2). Her blood pressure is 136/64 mm Hg. She has acanthosis nigricans on her neck and under her arms.

Laboratory test results:

- Hemoglobin A1c = 8.6% (4.0%-5.6%) (70 mmol/mol [20-38 mmol/mol])
- Creatinine = 1.1 mg/dL (0.6-1.1 mg/dL) (SI: 97.2 µmol/L [53.0-97.2 µmol/L])
- 25-Hydroxyvitamin D = 31 ng/mL (30-80 ng/mL [optimal]) (SI: 77.4 µmol/L [74.9-199.7 µmol/L])
- Calcium = 9.1 mg/dL (8.2-10.2 mg/dL) (SI: 2.3 µmol/L [2.1-2.6 µmol/L])

You counsel her to limit alcohol consumption and to increase weight-bearing exercise.
Which of the following medications should be added as the best next step in this patient’s diabetes management?

A. Canagliflozin  
B. Liraglutide  
C. Sitagliptin  
D. Pioglitazone  
E. Glipizide

Correct Answer: B

Learning objective:
Recommend the best treatment approach for type 2 diabetes mellitus in a patient with osteoporosis.
An 18-year-old man is seen for follow-up of hypoparathyroidism. He initially presented at age 3 years with a seizure and severe hypocalcemia. Since then, he has been maintained on calcium and calcitriol. He has also been treated for intermittent oral candidiasis and fungal infections of his fingernails and toenails since childhood. Otherwise, he feels well.

On physical examination, he has some tinea of the nails and negative Chvostek and Trousseau signs.

Laboratory test results are normal for the following: complete blood cell count, serum calcium, phosphate, creatinine, liver function, and 25-hydroxyvitamin D.
Which of the following additional tests is indicated now?

A. TPO antibody assessment
B. Antinuclear antibody assessment
C. Glutamic acid decarboxylase (GAD65) antibody assessment
D. 21-Hydroxylase antibody assessment
E. No further testing is indicated

Correct Answer: D

Learning objective:
Diagnose autoimmune polyendocrine syndrome type 1 as a cause of hypoparathyroidism and recommend appropriate screening
A 72-year-old man is noted to have a repeatedly low serum TSH level of less than 0.01 mIU/L. Thyroid hormone levels are normal. The patient’s only other medical problem is hypertension that is well controlled on a single agent. He feels well and has no complaints.

On physical examination, he has a left-sided nodule that is about 3 cm in dimension and feels firm to palpation.

A radioactive iodine uptake and scan shows homogeneously increased iodine uptake throughout the thyroid gland, but with a cold defect corresponding to the patient’s palpable left thyroid nodule. FNA biopsy of the nodule is performed under ultrasound guidance and the cytology is interpreted to be atypia of undetermined significance. No right lobe nodules are identified. Left lobectomy is performed and the nodule is found to be a benign hyperplastic nodule. A 7-mm papillary thyroid cancer is also identified. The surgical margins are negative.
Which of the following is the best next step in this patient’s management?

A. Completion thyroidectomy
B. Levothyroxine therapy to achieve a TSH level between 0.1 and 0.3 mIU/L
C. Radioactive iodine therapy
D. Another thyroid ultrasound
E. Monitoring of the patient’s TSH without further therapy now

Correct Answer: E

Learning objective:
Determine the appropriate management of microscopic papillary thyroid cancers.
A 41-year-old woman comes to the emergency department with severe abdominal pain and is admitted to the hospital for acute pancreatitis. This is her first episode of pancreatitis. She does not drink alcohol or smoke cigarettes. She started oral contraceptives 3 months ago for irregular menses but otherwise takes no medications.

On physical examination, she appears acutely ill. Her blood pressure is 142/84 mm Hg, and pulse rate is 112 beats/min. Her abdomen is diffusely tender on examination.

Laboratory test results (sample drawn in the emergency department):

- Total cholesterol = 414 mg/dL (<200 mg/dL [optimal]) (SI: 10.72 mmol/L [<5.18 mmol/L])
- HDL cholesterol = 21 mg/dL (>60 mg/dL [optimal]) (SI: 0.54 mmol/L [>1.55 mmol/L])
- LDL cholesterol, not determined
- Triglycerides = 2743 mg/dL (<150 mg/dL [optimal]) (SI: 31.00 mmol/L [<1.70 mmol/L])
- Amylase = 804 U/L (26-102 U/L) (SI: 13.43 µkat/L [0.43-1.70 µkat/L])
- ALT = 37 U/L (10-40 U/L) (SI: 0.62 µkat/L [0.17-0.67 µkat/L])
- Hemoglobin A1c = 5.1% (4.0%-5.6%) (32 mmol/mol [20-38 mmol/mol])
- Glucose = 220 mg/dL (70-99 mg/dL) (SI: 12.2 mmol/L [3.9-5.5 mmol/L])
In addition to stopping her oral contraceptive pill, ordering nothing by mouth except new medications, and providing intravenous fluids and pain control, which of the following should be started now?

A. Fish oil
B. Metformin
C. Fenofibrate
D. Insulin drip
E. Pioglitazone

Correct Answer: D

Learning objective:
Recommend insulin in the setting of hypertriglyceridemia-induced pancreatitis, even in the absence of known diabetes mellitus, to increase lipoprotein lipase synthesis and activity.
ITE 2019 Question 64

A 68-year-old man is referred to you after a retroperitoneal mass was incidentally identified on abdominal CT performed to investigate intermittent abdominal pain (see image, arrow). He has a 6-year history of poorly controlled hypertension, but no other notable medical history. His current medication regimen consists of hydrochlorothiazide and lisinopril. His brother was recently treated for a kidney tumor.
On physical examination, his height is 72.5 in (184.2 cm) and weight is 202 lb (91.8 kg) (BMI = 27 kg/m2). Fundoscopic examination reveals grade II hypertensive changes only (silver wiring, arteriovenous nicking). The rest of the examination findings are normal.

Laboratory test results:

- Urinary catecholamine fractionation:
  - Dopamine = 480 µg/24 h (<700 µg/24 h) (SI: 3132 nmol/d [<4567 nmol/d])
  - Epinephrine = 25 µg/24 h (<35 µg/24 h) (SI: 136 nmol/d [<191 nmol/d])
  - Norepinephrine = 568 µg/24 h (<170 µg/24 h) (SI: 3359 nmol/d [<1005 nmol/d])
Which of the following genes should be tested first to search for a pathogenic variant?

A. VHL (von Hippel–Lindau tumor suppressor)
B. SDHB (succinate dehydrogenase complex, subunit B)
C. SDHC (succinate dehydrogenase complex, subunit C)
D. SDHD (succinate dehydrogenase complex, subunit D)
E. Genetic testing is not indicated

Correct Answer: B

Learning objective:
Determine the optimal sequence of genetic testing in paraganglioma/pheochromocytoma on the basis of clinical, imaging, and biochemical findings at presentation.
ITE 2019 Question 65

A 33-year-old man presents with low libido and erectile dysfunction with loss of morning erections for the last 5 months. There is no history of head or testicular trauma. He is married and has 2 biologic children. His medical history is notable for rheumatoid arthritis diagnosed 9 months ago. He was started on methotrexate, 7.5 mg weekly, but had persistent painful and swollen joints, particularly his knees. He did not want to start oral glucocorticoid therapy, so he has had injections of methylprednisolone and triamcinolone every 6 to 8 weeks for knee pain.

On physical examination, his BMI is 32 kg/m², phallus is normal, and testes are 15 mL bilaterally and without masses. The patient has swelling of the distal interphalangeal joints.

Laboratory test results:

- Total testosterone (8 AM) = 151 ng/dL (300-900 ng/dL) (SI: 5.2 nmol/L [10.4-31.2 nmol/L])
- LH = 2.9 mIU/mL (1.0-9.0 mIU/mL) (SI: 2.9 IU/L [1.0-9.0 IU/L])
- FSH = 3.3 mIU/mL (1.0-13.0 mIU/mL) (SI: 3.3 IU/L [1.0-13.0 IU/L])
- Prolactin = 13 ng/mL (4-23 ng/mL) (SI: 0.6 nmol/L [0.17-1.00 nmol/L])
- TSH = 1.1 mIU/L (0.5-5.0 mIU/L)
- Free T4 = 1.4 ng/dL (0.8-1.8 ng/dL) (SI: 18.0 pmol/L [10.30-23.17 pmol/L])
- IGF-1 = 134 ng/mL (113-297 ng/mL) (SI: 17.6 nmol/L [14.8-38.9 nmol/L])
- Glucose (fasting) = 116 mg/dL (70-99 mg/dL) (SI: 6.4 mmol/L [3.9-5.5 mmol/L])
- Transferrin saturation = 32% (14%-50%)

Pituitary MRI shows empty sella.
Which of the following is responsible for the patient’s androgen deficiency?

A. Empty sella
B. Methotrexate
C. Methylprednisolone
D. Hemochromatosis

Correct Answer: C

Learning objective:
Diagnose glucocorticoid-induced hypogonadism.
ITE 2019 Question 66

A 32-year-old man with widely invasive follicular thyroid cancer undergoes total thyroidectomy followed by radioiodine remnant ablation with 150 mCi $^{131}$I. He subsequently develops lung metastases and is treated with an additional 200 mCi, with an objective decrease in the size of the lung metastases and reduction in serum thyroglobulin levels.
Which of the following is the most likely adverse effect from this patient’s therapy with radioiodine?

A. Permanent loss of taste  
B. Excessive dental caries  
C. Azoospermia  
D. Leukemia  
E. Hypoparathyroidism

Correct Answer: B  
Learning objective:  
Anticipate the most likely adverse effects of high-dose radioactive iodine treatment.
ITE 2019 Question 67

A 63-year-old woman returns for management of osteoporosis. She has no fracture history, although her mother had sustained a hip fracture from a ground-level fall at age 80 years. On the patient’s baseline DXA scan performed 2 years ago, she was documented to have low bone mineral density (see table). No secondary causes of low bone mineral density were identified and the patient was prescribed daily teriparatide, which she has taken consistently for the past 2 years. She also takes supplemental calcium, 1000 mg daily, and over-the-counter vitamin D, 1000 IU daily. She exercises regularly and does not smoke cigarettes or drink alcohol. Her most recent DXA scan this year documented a significant improvement in bone mass.

<table>
<thead>
<tr>
<th>Region</th>
<th>Age at the Time of DXA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>61 Years</td>
</tr>
<tr>
<td>Lumbar spine T-score</td>
<td>–3.1</td>
</tr>
<tr>
<td>Femoral neck T-score</td>
<td>–2.4</td>
</tr>
</tbody>
</table>
Laboratory test results:
- Complete blood count, normal
- Comprehensive chemistry panel, normal
- Serum osteocalcin
  - Pretreatment = 31 ng/mL (SI: 31 µg/L)
  - Posttreatment = 66 ng/mL (SI: 66 µg/L)
In discussing her future management, which of the following sets of results would be most likely 1 year from now if you were to elect no further therapy?

<table>
<thead>
<tr>
<th>Answer</th>
<th>Lumbar Spine Bone Mineral Density</th>
<th>Serum Osteocalcin</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>Unchanged</td>
<td>Lower</td>
</tr>
<tr>
<td>B.</td>
<td>Lower</td>
<td>Lower</td>
</tr>
<tr>
<td>C.</td>
<td>Higher</td>
<td>Lower</td>
</tr>
<tr>
<td>D.</td>
<td>Higher</td>
<td>Higher</td>
</tr>
<tr>
<td>E.</td>
<td>Lower</td>
<td>Unchanged</td>
</tr>
</tbody>
</table>

Correct Answer: B

Learning objective:
In a patient with osteoporosis who discontinues an anabolic agent, predict the effects of therapy cessation on bone mineral density and markers of bone turnover.
ITE 2017 Question 68

A 32-year-old woman with a 10-year history of type 1 diabetes mellitus is referred for a second opinion regarding her unexplained high hemoglobin A1c levels. Her diabetes is managed with insulin pump therapy. Self-monitoring of blood glucose performed 8 to 12 times daily shows values ranging between 80 and 110 mg/dL (4.4-6.1 mmol/L) before meals and between 100 and 130 mg/dL (5.6-7.2 mmol/L) 2 hours after meals. She does not report hypoglycemic episodes. Her review of systems is notable for recent fatigue and lightheadedness. Her periods have been regular but very heavy for the past year. Her last menstrual period was 3 weeks ago. Her medications include aspirin and ramipril. Her hemoglobin A1c level had been in the range of 5.5% to 6.2% (37-44 mmol/mol) for years, but 4 months ago it was 7.8% (62 mmol/mol) and a recent value was 8.2% (66 mmol/mol).

Laboratory test results:

- Serum creatinine = 1.1 mg/dL (0.6-1.1 mg/dL) (SI: 97.2 µmol/L [53.0-97.2 µmol/L])
- Liver enzymes, normal
- TSH, normal
- Urine albumin-to-creatinine ratio = 95 mg/g (<30 mg/g)
Which of the following is most likely the cause of her high hemoglobin A1c levels?

A. Nocturnal hyperglycemia
B. Laboratory error
C. Hemolysis
D. Pregnancy
E. Iron deficiency

Correct Answer: E

Learning objective:
Identify iron deficiency anemia as a cause of falsely high hemoglobin A1c values.
ITE 2019 Question 69

A 22-year-old woman is sent for evaluation of irregular menses and hirsutism. She reports that she developed pubic hair and body odor at age 4 years and was diagnosed with “premature adrenarche,” but no testing was performed. She was tall relative to her peers until sixth grade, when she stopped growing. She had menarche at age 10.5 years, and she developed acne, facial hair, and menstrual irregularities starting at age 14 years. Her last menstrual period was 3 months ago. She has a brother who was also a tall child but stopped growing in the sixth grade and a sister who had normal growth and development and now has regular monthly menses.

On physical examination, her blood pressure is 115/70 mm Hg and BMI is 23 kg/m2. She has coarse terminal hair stubble on her chin, upper lip, and sides of her face and acne on her cheeks and forehead. She has no moon facies, dermal atrophy, myopathy, striae, or acanthosis nigricans. Pelvic examination findings are normal, including typical external genitalia.

Laboratory test results:

- Serum testosterone = 60 ng/dL (8-60 ng/dL) (SI: 2.1 nmol/L [0.3-2.1 nmol/L])
- Serum DHEA-S = 545 µg/dL (44-332 µg/dL) (SI: 14.8 µmol/L [1.19-9.00 µmol/L])
- Serum 17-hydroxyprogesterone = 300 ng/dL (<80 ng/dL [follicular]; <285 ng/dL [luteal]; <51 ng/dL [postmenopausal]) (SI: 9.1 nmol/L [<2.42 nmol/L (follicular)]; [<8.64 nmol/L (luteal)]; [<1.55 nmol/L (postmenopausal)])
Which of the following is the most appropriate next step in this patient’s evaluation?

A. ACTH-stimulation test measuring 17-hydroxyprogesterone and cortisol
B. ACTH-stimulation test measuring 17-hydroxypregnenolone and DHEA
C. Adrenal-directed CT
D. Plasma ACTH measurement
E. No further testing

Correct Answer: A

Learning objective:
Guide the biochemical evaluation of adrenal androgen excess.
A 45-year-old woman with a 20-year history of type 1 diabetes mellitus that has been complicated by nephropathy and retinopathy is referred for help achieving better glycemic control. Her current regimen consists of insulin glargine once daily and insulin lispro with meals. Self-monitoring of blood glucose (8 times daily) shows values ranging between 150 and 300 mg/dL (8.3-16.7 mmol/L). Her hemoglobin A1c level has been between 8.5% and 10.0% (69-86 mmol/mol). Her menses are regular. She has sickle cell disease without recent crises, but concern about the hemoglobinopathy prompted measurement of a fructosamine along with her routine laboratory tests.

Laboratory test results:

- Hemoglobin A1c = 9.0% (4.0%-5.6%) (75 mmol/mol [20-38 mmol/mol])
- Serum creatinine = 2.2 mg/dL (0.6-1.1 mg/dL) (SI: 194.5 µmol/L [53.0-97.2 µmol/L])
- Urine albumin-to-creatinine ratio = 3886 mg/g (<30 mg/g)
- Liver function, normal
- TSH = 7.5 mIU/L (0.5-5.0 mIU/L)
- Serum fructosamine = 210 µmol/L (205-285 µmol/L)
The discrepancy between this patient’s hemoglobin A1c and fructosamine levels is most likely caused by which of the following?

A. Laboratory error
B. Sickle cell disease
C. Hemolysis
D. Hypothyroidism
E. Proteinuria

Correct Answer: E

Learning objective:
Identify nephrotic syndrome as a cause of falsely low fructosamine.
An 18-year-old woman is seen for the recent development of erratic blood glucose values. Type 1 diabetes mellitus was diagnosed 2 years ago, and a regimen of once-daily insulin glargine and mealtime insulin lispro was initiated. Her glycemic control has always been adequate, with hemoglobin A1c values around 7.0% (53 mmol/mol). However, a few weeks ago, she started to notice recurrent symptomatic hypoglycemic episodes (blood glucose values between 45 and 60 mg/dL [2.5-3.3 mmol/L]) that occur mainly after meals. Despite eating more snacks to prevent hypoglycemia, she has lost 4 lb (1.8 kg) in the past 2 weeks. She has no gastrointestinal complaints or lightheadedness. Her menses are regular.

Her BMI is 22 kg/m2, and blood pressure is 125/80 mm Hg. Findings on thyroid and abdominal examinations are unremarkable. No hyperpigmentation is noted.

Laboratory test results:

- Hemoglobin A1c = 6.7% (4.0%-5.6%) (50 mmol/mol [20-38 mmol/mol])
- Electrolytes, normal
- Creatinine, normal
- Liver function, normal
- Complete blood cell count, normal
An elevation in which of the following would most likely identify the underlying cause of her hypoglycemia?

A. ACTH
B. Free $T_4$
C. Tissue transglutaminase IgA antibodies
D. 21-Hydroxylase antibodies
E. Glutamic acid decarboxylase 65 antibodies

Correct Answer: C

Learning objective:
Describe the association of celiac disease with type 1 diabetes mellitus and recognize its presentation.
A 67-year-old man presents with fatigue, low libido, poor erectile function, and a decrease in sexual activity with his partner that is causing problems in their relationship. He has hypertension controlled on lisinopril and hydrochlorothiazide and class I obesity (BMI = 34 kg/m²). He wants to start testosterone replacement if it will improve his sexual function. He has no known cardiovascular disease.

Laboratory test results:

- Total testosterone = 230 ng/dL (300-900 ng/dL) (SI: 8.0 nmol/L [10.4-31.2 nmol/L])
- FSH = 2.0 mIU/mL (1.0-13.0 mIU/mL) (SI: 2.0 IU/L [1.0-13.0 IU/L])
- LH = 3.0 mIU/mL (1.0-9.0 mIU/mL) (SI: 3.0 IU/L [1.0-9.0 IU/L])
Which of the following patterns would best represent the effects of testosterone replacement in this older man with late-onset hypogonadism?

<table>
<thead>
<tr>
<th>Answer</th>
<th>Libido</th>
<th>Erectile Function</th>
<th>Sexual Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>Increased</td>
<td>Improved</td>
<td>Increased</td>
</tr>
<tr>
<td>B.</td>
<td>Increased</td>
<td>No change</td>
<td>No change</td>
</tr>
<tr>
<td>C.</td>
<td>No change</td>
<td>Improved</td>
<td>No change</td>
</tr>
<tr>
<td>D.</td>
<td>No change</td>
<td>No change</td>
<td>No change</td>
</tr>
</tbody>
</table>

Correct Answer: A

Learning objective:
Counsel patients regarding the benefits of testosterone therapy on sexual function in symptomatic older men with late-onset hypogonadism and unequivocally low testosterone levels.
ITE 2019 Question 73

A 50-year-old woman is referred for recommendations on treatment of osteoporosis that was recently identified by DXA scan. She has no history of low-trauma fractures as an adult. Her medical history is notable only for hypertension treated with lisinopril. She underwent natural menopause at age 46 years and did not take hormone therapy. She does not take calcium or vitamin D supplements, but she does consume 4 servings of dairy products per day. Her family history is notable for osteoporosis in her father who suffered a hip fracture in his 70s. Review of systems is notable for vague bilateral lower leg pain that is longstanding and worse with ambulation. She has no significant height loss.

On physical examination, she has no evident thoracic kyphosis. There is moderate anterior tibial tenderness to direct palpation. The rest of her examination findings are noncontributory.
Laboratory test results:

- Serum calcium = 8.3 mg/dL (8.2-10.2 mg/dL) (SI: 2.1 mmol/L [2.1-2.6 mmol/L])
- Serum phosphate = 2.3 mg/dL (2.3-4.7 mg/dL) (SI: 0.7 mmol/L [0.7-1.5 mmol/L])
- Serum creatinine = 0.9 mg/dL (0.6-1.1 mg/dL) (SI: 79.6 µmol/L [53.0-97.2 µmol/L])
- Serum albumin = 4.4 mg/dL (3.5-5.0 g/dL) (SI: 44 g/L [35-50 g/L])
- Serum intact PTH = 90 pg/mL (10-65 pg/mL) (SI: 90 ng/L [10-65 ng/L])
- Serum 25-hydroxyvitamin D = 9 ng/dL (25-80 ng/mL) (SI: 22.5 nmol/L [62.4-199.7 nmol/L])
- Alkaline phosphatase = 145 U/L (50-120 U/L) (SI: 2.42 µkat/L [0.84-2.00 µkat/L])
- AST = 25 U/L (20-48 U/L) (SI: 0.42 µkat/L [0.33-0.80 µkat/L])
- ALT = 30 U/L (10-40 U/L) (SI: 0.50 µkat/L [0.17-0.67 µkat/L])
DXA results are shown (see images and tables):
<table>
<thead>
<tr>
<th>Region</th>
<th>BMD, g/cm²</th>
<th>T-Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1</td>
<td>0.642</td>
<td>−4.3</td>
</tr>
<tr>
<td>L2</td>
<td>0.703</td>
<td>−4.5</td>
</tr>
<tr>
<td>L3</td>
<td>0.698</td>
<td>−4.5</td>
</tr>
<tr>
<td>L4</td>
<td>0.618</td>
<td>−5.2</td>
</tr>
<tr>
<td>Total</td>
<td>0.662</td>
<td>−4.6</td>
</tr>
<tr>
<td>Region</td>
<td>BMD, g/cm²</td>
<td>T-Score</td>
</tr>
<tr>
<td>----------</td>
<td>------------</td>
<td>---------</td>
</tr>
<tr>
<td>Neck</td>
<td>0.682</td>
<td>-3.0</td>
</tr>
<tr>
<td>Total</td>
<td>0.788</td>
<td>-2.2</td>
</tr>
</tbody>
</table>
Which of the following is the most appropriate treatment in the management of this patient’s bone disorder?

A. Ergocalciferol  
B. Alendronate  
C. Zoledronic acid  
D. Calcium citrate  
E. Elemental phosphorus and calcitriol

Correct Answer: A

Learning objective:
Identify subclinical osteomalacia due to vitamin D deficiency in a patient with osteoporosis and explain the importance of vitamin D repletion before bisphosphonate treatment.
A 43-year-old man with an 18-year history of type 1 diabetes mellitus complicated by retinopathy, nephropathy, and gastroparesis schedules a visit to discuss evening hypoglycemia. He has been managed on an insulin pump for the past 2 years with overall improved control. He is using insulin aspart in his pump and reports no problems related to use of the device or with his infusion set sites. He has received education and is confident regarding estimation of his carbohydrate intake at meals. He reports consistently using his insulin pump bolus calculator to estimate his mealtime and correction insulin doses, which he administers at the start of meals.

He reports several episodes of hypoglycemia that have occurred within 1 hour of bolusing for an evening meal. His appetite has been good and he denies postprandial nausea or bloating. He is eating a low-residue diet but notes that his evening meals are larger and higher in fat than the meals eaten earlier in the day.
His current insulin pump settings are as follows:

**Basal Rates**
- Midnight: 1.0 units/h
- 6 AM: 0.8 units/h
- 6 PM: 1.0 units/h

**Insulin-to-Carbohydrate Ratio**
- Midnight: 1 unit per 14 g carbohydrate
- 6 AM: 1 unit per 12 g carbohydrate
- 6 PM: 1 unit per 10 g carbohydrate

Average total daily insulin dose: 45 units; 48% basal, 52% bolus
Blood glucose target: 120-140 mg/dL mg/dL (6.7-7.8 mmol/L)
Insulin sensitivity (correction) factor: 40 mg/dL (2.2 mmol/L)
Duration of insulin action: 5 hours

Laboratory test results:

- Hemoglobin A_{1c} = 7.9% (4.0%-5.6%) (63 mmol/mol [20-38 mmol/mol])
- Creatinine = 1.2 mg/dL (0.7-1.3 mg/dL) (SI: 106.1 µmol/L [61.9-114.96 µmol/L])
You review the results of a continuously monitored glucose profile showing the following results for 4 days of use:
Which of the following should you recommend now to address his glycemic instability in the evening and overnight hours?

A. Extend evening-meal bolus delivery over a 4-hour period
B. Increase to 1 unit of insulin per 8 g carbohydrate at 6 PM
C. Administer mealtime bolus 1 hour after the start of evening meals
D. Increase the midnight basal rate to 1.2 units/h
E. Increase the 6-PM basal rate to 1.2 units/h

Correct Answer: A

Learning objective:
Use the results of continuous glucose monitoring to adjust bolus insulin delivery.
ITE 2019 Question 75

A 62-year-old man with a 10-year history of type 2 diabetes mellitus seeks help for erectile dysfunction. He reports a normal libido. He has a sedentary desk job and does not have time to exercise. He has hypertension and dyslipidemia. He takes atorvastatin, 40 mg daily; ramipril; and metformin.

On physical examination, his blood pressure is 128/72 mm Hg, pulse rate is 68 beats/min, and BMI is 37 kg/m2. He is well virilized, and he has 20-mL testes bilaterally. Findings on cardiopulmonary, abdominal, and neurologic examinations are normal.

Laboratory test results (sample drawn when fasting):

- Total testosterone = 280 ng/dL (300-900 ng/dL) (SI: 9.7 nmol/L [10.4-31.2 nmol/L])
- Total cholesterol = 215 mg/dL (<200 mg/dL [optimal]) (SI: 5.57 nmol/L [<5.18 mmol/L])
- HDL cholesterol = 35 mg/dL (>60 mg/dL [optimal]) (SI: 0.91 nmol/L [>1.55 mmol/L])
- LDL cholesterol = 115 mg/dL (<100 mg/dL [optimal]) (SI: 2.98 nmol/L [<2.59 mmol/L])
- Triglycerides = 200 mg/dL (<150 mg/dL [optimal]) (SI: 2.26 nmol/L [<1.70 mmol/L])
- Hemoglobin A1c = 7.2% (4.0%-5.6%) (55 mmol/mol [20-38 mmol/mol])
Which of the following is the best next step in the evaluation and management of his erectile dysfunction?

A. Measurement of free testosterone
B. Exercise tolerance test
C. Intensification of his glucose-lowering regimen
D. Addition of a second drug to treat his dyslipidemia
E. Trial of an oral phosphodiesterase inhibitor

Correct Answer: B

Learning objective:
Determine whether a patient needs formal cardiovascular assessment before starting an oral phosphodiesterase inhibitor for erectile dysfunction
A 42-year-old woman who is currently 10 weeks pregnant is referred to you for assistance in the management of hypercalcemia. Six months ago, a screening chemistry panel revealed a calcium concentration of 11.1 mg/dL (SI: 2.78 mmol/L) and a normal creatinine concentration of 0.7 mg/dL (SI: 61.9 µmol/L). Several calcium measurements in her 20s and 30s were normal.

Six weeks ago, the patient returned for further laboratory tests when she had a positive home pregnancy test:

- **Calcium = 10.8 mg/dL (8.2-10.2 mg/dL) (SI: 2.7 mmol/L [2.1-2.6 mmol/L])**
- **Albumin = 4.0 g/dL (3.5-5.0 g/dL) (SI: 40 g/L [35-50 g/L])**
- **Alkaline phosphatase = 42 U/L (50-120 U/L) (SI: 0.70 µkat/L [0.84-2.00 µkat/L])**
- **PTH = 95.7 pg/mL (10-65 pg/mL) (SI: 95.7 ng/L [10-65 ng/L])**
- **25-Hydroxyvitamin D = 28 ng/mL (30-80 ng/mL [optimal]) (SI: 69.9 nmol/L [74.9-199.7 nmol/L])**
- **1,25-Dihydroxyvitamin D = 84 pg/mL (16-65 pg/mL) (SI: 218.4 pmol/L [41.6-169.0 pmol/L])**
- **Urinary calcium = 281 mg/24 h (100-300 mg/24 h) (SI: 7.0 mmol/d [2.5-7.5 mmol/d])**

Physical examination findings are normal, including those from head and neck exam.

She is reluctant to do anything regarding her hypercalcemia out of concern for the fetus. The pregnancy progresses normally and the patient’s calcium concentration remains between 10.7 mg/dL and 11.3 mg/dL (2.7-2.8 mmol/L). The baby is delivered vaginally at 40 weeks’ gestation.
Which of the following represents the most likely immediate postpartum complication for the baby?

A. Hyperparathyroidism
B. Hypocalcemia
C. Fracture
D. Nephrocalcinosis
E. Nephrolithiasis

Correct Answer: B

Learning objective:
Counsel patients on the risk of maternal primary hyperparathyroidism to the developing fetus and newborn and review the physiology of calcium homeostasis in pregnancy.
A 32-year-old woman in her second trimester of pregnancy presents to the ophthalmologist for a dilated eye examination. She has no known history of diabetic ophthalmopathy or any other diabetes-associated complications. The left image shows a picture of her dilated fundus from an examination several years ago, and the right image shows a picture from her current examination.
The images shown depict which of the following:

<table>
<thead>
<tr>
<th>Answer</th>
<th>Left Image</th>
<th>Right Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>Normal retina</td>
<td>Microaneurysms</td>
</tr>
<tr>
<td>B.</td>
<td>Normal retina</td>
<td>Severe nonproliferative diabetic retinopathy with retinal hemorrhages and hard exudates</td>
</tr>
<tr>
<td>C.</td>
<td>Nonproliferative diabetic retinopathy</td>
<td>Proliferative diabetic retinopathy</td>
</tr>
<tr>
<td>D.</td>
<td>Nonproliferative diabetic retinopathy</td>
<td>Proliferative retinopathy with laser scars</td>
</tr>
<tr>
<td>E.</td>
<td>Soft exudates</td>
<td>Hard exudates</td>
</tr>
</tbody>
</table>

**Correct Answer: B. B**

**Learning objective:**
Characterize diabetic retinopathy and explain the effects of pregnancy on retinopathy progression.
ITE 2019 Question 78

A 36-year-old woman has developed hypertension, hirsutism, and wide, purple striae on her abdomen as she enters her second trimester of pregnancy.

Laboratory test results:

- Serum cortisol (8 AM) = 33 μg/dL (5-25 μg/dL) (SI: 910.4 nmol/L [137.9-689.7 nmol/L])
- ACTH = 145 pg/mL (10-60 pg/mL) (SI: 31.9 pmol/L [2.2-13.2 pmol/L])
- Urinary free cortisol = 375 µg/24 h (4-50 µg/24 h) (SI: 1035 nmol/d [11-138 nmol/d])
- MRI shows a 6-mm pituitary adenoma.
Which of the following options should you recommend?

A. Defer therapy until after delivery
B. Begin ketoconazole
C. Begin mifepristone
D. Begin pasireotide
E. Refer for transsphenoidal surgery

Correct Answer: E
Learning objective:
Treat Cushing disease during pregnancy.
ITE 2019 Question 79

A 59-year-old woman with postsurgical hypothyroidism presents for routine follow-up. She has been on a stable levothyroxine dosage for many years. In addition to hypothyroidism, her medical history is notable only for newly diagnosed osteopenia, for which she has started raloxifene and vitamin D, taken at 7AM along with her levothyroxine. She also started calcium carbonate, taken with lunch and evening meals. She describes feeling fatigued, which is new since her last visit. Her serum TSH level is 11.3 mIU/L (0.5-5.0 mIU/L).
Which of the following is the most likely reason for her serum TSH elevation?

A. Medication nonadherence
B. Raloxifene
C. Calcium supplementation
D. Celiac disease
E. Vitamin D supplementation

Correct Answer: B

Learning objective:
Identify raloxifene as an agent that may alter levothyroxine requirements.
ITE 2019 Question 80

A 42-year-old man presents with bilateral hip pain and the radiographic findings shown (see image). He underwent Roux-en-Y gastric bypass surgery for morbid obesity 3 years ago and has lost more than 100 lb (45.5 kg).
Laboratory test results:

- Serum calcium = 8.2 mg/dL (8.2-10.2 mg/dL) (SI: 2.1 mmol/L [2.1-2.6 mmol/L])
- Phosphate = 2.2 mg/dL (2.3-4.7 mg/dL) (SI: 0.7 mmol/L [0.7-1.5 mmol/L])
- Creatinine = 0.9 mg/dL (0.7-1.3 mg/dL) (SI: 79.6 µmol/L [61.9-114.9 µmol/L])
- Serum alkaline phosphatase = 346 U/L (50-120 U/L) (SI: 5.78 µkat/L [0.84-2.00 µkat/L])
Measurement of which of the following is most likely to provide this patient’s diagnosis?

A. 25-Hydroxyvitamin D  
B. 1,25-Dihydroxyvitamin D  
C. FGF-23  
D. Intact PTH  
E. C-telopeptide  

Correct Answer: A  
Learning objective:  
Identify clinical and radiographic findings in osteomalacia after gastric bypass (severe vitamin D deficiency).
ITE 2019 Question 81

A 66-year-old woman with follicular thyroid cancer and known distant metastases reports rib pain. She initially underwent thyroidectomy 8 years ago, and she has received multiple doses of radioiodine therapy, the last of which was 1 year ago. Her posttreatment scans have been negative.

Laboratory test results:

- TSH = 0.03 mIU/L (0.5-5.0 mIU/L)
- Thyroglobulin = 3600 ng/mL (<1.0 ng/mL) (SI: 3600 µg/L [<1.0 µg/L])
- Thyroglobulin antibodies, negative

PET-CT demonstrates diffuse bone metastases in the ribs and spine.
Which of the following is most likely to reduce the risk of skeletal complications of her thyroid cancer?

A. Total-body irradiation
B. Zoledronic acid
C. Systemic chemotherapy with alkylating agents
D. Teriparatide
E. Dosimetry-based radioiodine

Correct Answer: B

Learning objective:
Discuss the benefits of bisphosphonate therapy in patients with bone metastases from thyroid cancer.
A 54-year-old woman with a history of HIV infection and asthma presents with polyuria, polydipsia, and a blood glucose value of 317 mg/dL (17.6 mmol/L). She has no history of hyperglycemia or diabetes mellitus. HIV was diagnosed 20 years ago and is well controlled, with a recent CD4 cell count greater than 500 and an undetectable viral load. Her medication regimen includes darunavir (protease inhibitor), ritonavir (protease inhibitor), etravirine (nonnucleoside reverse transcriptase inhibitor), emtricitabine (nucleoside reverse transcriptase inhibitor), inhaled fluticasone (250 mcg twice daily), salmeterol (50 mcg twice daily), atorvastatin, and lisinopril.

On physical examination, she has several features of Cushing syndrome, including moon facies, dorsocervical fat pad, central adiposity, lipoatrophy of the arms and legs, and violaceous striae.
Her primary care physician had measured morning cortisol, which returned surprisingly low at 1.7 µg/dL (46.9 nmol/L) and prompted further testing (ACTH-stimulation test):

<table>
<thead>
<tr>
<th>Measurement</th>
<th>8 AM</th>
<th>9 AM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cortisol</td>
<td>1.3 µg/dL (SI: 35.7 nmol/L)</td>
<td>8.4 µg/dL (SI: 231.7 nmol/L)</td>
</tr>
<tr>
<td>ACTH</td>
<td>&lt;5 pg/mL (SI: 1.1 pmol/L)</td>
<td>Administration of intravenous cosyntropin, 250 mcg</td>
</tr>
<tr>
<td>Aldosterone</td>
<td>4.3 ng/dL (SI: 119.3 pmol/L)</td>
<td>8.9 ng/dL (SI: 246.9 pmol/L)</td>
</tr>
<tr>
<td>Plasma renin activity</td>
<td>1.1 ng/mL per h</td>
<td>...</td>
</tr>
</tbody>
</table>
Which of the following is the most likely diagnosis?

A. Primary adrenal insufficiency
B. Fluticasone-induced secondary adrenal insufficiency
C. Cortisol-producing adrenal adenoma
D. Ectopic ACTH secretion and Cushing syndrome
E. ACTH-secreting pituitary adenoma

Correct Answer: B

Learning objective:
Diagnose secondary adrenal insufficiency in a patient taking ritonavir (a protease inhibitor that inhibits CYP3A4 activity) and glucocorticoids.
ITE 2019 Question 83
A 17-year-old woman with a history of pancreatic islet-cell tumors related to multiple endocrine neoplasia type 1 (MEN 1) is referred for evaluation. The diagnosis of MEN 1 was confirmed by genetic testing 7 years ago. Her father was also affected, and he died 2 years ago of metastatic islet-cell tumor. The patient has had multiple episodes of adrenergic symptoms with accompanying confusion over the past 6 months, and hypoglycemia with concomitant elevation of β-cell polypeptides has been documented on 2 occasions. She is known to have multiple tumors with 2 dominant lesions measuring 3.0 and 4.5 cm in the head of the pancreas. Over the past 3 years of observation, there has been a clear size increase in the larger of the 2 tumors. The patient is otherwise in good health with normocalcemia and no previous parathyroid surgeries. Her menses are regular, and she has no galactorrhea.
Which of the following should be recommended to this patient?

A. Selective arterial calcium-stimulation test  
B. Enucleation of the lesions in the head of the pancreas  
C. An outpatient fast to document hypoglycemia  
D. Endoscopic ultrasonography  
E. No further testing now

Correct Answer: A

Learning objective:
Manage functional islet-cell tumors in patients with multiple endocrine neoplasia type 1.
A 43-year-old woman who is having difficulty losing weight is referred for abnormal thyroid function test results. She is otherwise asymptomatic and takes no medications. Her mother has hypothyroidism. On physical examination, her pulse rate is 84 beats/min, her thyroid is slightly enlarged without nodules or bruit, there is no tremor, and deep tendon reflexes are normal.

Laboratory test results:

- TSH = 0.01 mIU/L (0.5-5.0 mIU/L)
- Free $T_4$ = 1.7 ng/dL (0.8-1.8 ng/dL) (SI: 21.9 pmol/L [10.30-23.17 pmol/L])
- Total $T_3$ = 150 ng/dL (70-200 ng/dL) (SI: 2.3 nmol/L [1.08-3.08 nmol/L])
- Radioactive iodine uptake = 22% at 24 hours (15%-30%)
Which of the following is the best next step in this patient's management?

A. Start methimazole, 20 mg daily
B. Start atenolol, 50 mg daily
C. Treat with radioiodine therapy
D. Repeat laboratory tests in 3 months

Correct Answer: D

Learning objective:
Describe the natural history of nonnodular causes of subclinical hyperthyroidism.
A 39-year-old man seeks evaluation for a documented elevated LDL-cholesterol level. His father died of a myocardial infarction at age 29 years and his brother developed angina at age 32 years. The patient has intermittent chest pain that is consistent with angina, but he has not had any diagnostic testing. He is taking atorvastatin, 40 mg daily, and on this medication his fasting LDL-cholesterol level is 245 mg/dL (6.35 mmol/L). On physical examination, he has thickened Achilles tendons and nodules on the extensor tendons of his hands.
Which of the following medications should be added as the best next step?

A. Ezetimibe  
B. Fenofibrate  
C. Evolocumab  
D. Niacin

Correct Answer: C

Learning objective:
Summarize the utility of PCSK9 inhibitors in the treatment of patients with familial hypercholesterolemia.
An 82-year-old man presents for evaluation of a 6-month history of hip pain. The pain is worse at rest and wakes him up at night. Monostotic Paget disease of the right pelvis was diagnosed approximately 10 years ago and was treated with daily alendronate (40 mg) for 6 months. His pain resolved, and he did not feel the need to follow-up until now. He has no family history of Paget disease and no personal history of radiation exposure to the bone. His last PSA measurement and digital rectal examination findings were normal.

On physical examination, he is an elderly man with an antalgic gait and he is in mild to moderate distress. His height is 65 in (165 cm), and weight is 178 lb (80.9 kg) (BMI = 29.6 kg/m²). There is warmth over the region of the right hip. Range of motion is limited by pain. No other joints appear to be involved.

Laboratory test results:

Creatinine = 0.83 mg/dL (0.7-1.3 mg/dL) (SI: 73.4 µmol/L [61.9-114.9 µmol/L])
Calcium = 9.4 mg/dL (8.2-10.2 mg/dL) (SI: 2.4 mmol/L [2.1-2.6 mmol/L])
25-Hydroxyvitamin D = 28 ng/mL (30-80 ng/mL [optimal]) (SI: 69.9 nmol/L [74.9-199.7 nmol/L])
Alkaline phosphatase = 355 U/L (50-120 U/L) (SI: 5.93 µkat/L [0.84-2.00 µkat/L])
PTH = 45 pg/mL (10-65 pg/mL) (SI: 45 ng/L [10-65 ng/L])
PSA = 0.5 ng/mL (<7.2 ng/mL) (SI: 0.5 µg/L [<7.2 µg/L])
Hematocrit, normal
Urinary calcium, normal
The following shows the trend of his alkaline phosphatase concentrations over the past 6 years (see table).

<table>
<thead>
<tr>
<th>Measurement</th>
<th>6 Years Ago</th>
<th>5 Years Ago</th>
<th>4 Years Ago</th>
<th>3 Years Ago</th>
<th>2 Years Ago</th>
<th>1 Year Ago</th>
<th>6 Months Ago</th>
<th>3 Months Ago</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alkaline Phosphatase</td>
<td>47 U/L (SI: 0.78 µkat/L)</td>
<td>48 U/L (SI: 0.80 µkat/L)</td>
<td>55 U/L (SI: 0.92 µkat/L)</td>
<td>91 U/L (SI: 1.52 µkat/L)</td>
<td>83 U/L (SI: 1.39 µkat/L)</td>
<td>185 U/L (SI: 3.09 µkat/L)</td>
<td>255 U/L (SI: 4.26 µkat/L)</td>
<td>270 U/L (SI: 4.51 µkat/L)</td>
</tr>
</tbody>
</table>
Plain film of the pelvis (see image) reveals the finding marked by the arrow.
Which of the following is the most likely cause of this patient’s clinical scenario?

A. Osteoarthritis  
B. Pathologic fracture from metastatic prostate cancer  
C. Subtrochanteric stress fracture  
D. Development of osteosarcoma  
E. Development of an additional pagetoid lesion

Correct Answer: D
Learning objective:  
Identify transformation of Paget disease to osteosarcoma.
ITE 2019 Question 87

A 23-year-old woman is referred for evaluation of weight gain and difficulty sleeping. She has just graduated from college and is having trouble finding a job. She reports a 15.5-lb (7-kg) weight gain over the past 3 months even though she thinks her caloric intake has been low and physical activity has been high. Her current weight is 145 lb (66 kg). At night, she has had difficulty falling asleep and staying asleep. She takes norgestimate-ethinyl estradiol daily for contraception.

On physical examination, her blood pressure is 131/92 mm Hg. She has a small dorsocervical fat pad, but no obvious moon facies, supraclavicular fat pads, striae, lipoatrophy, or lipodystrophy.

Her primary care physician had performed an evaluation for Cushing syndrome (testing performed at 8 AM following 1-mg of dexamethasone taken at 11 PM the night before):

\[
\begin{align*}
\text{Cortisol} & = 30 \, \mu\text{g/dL} \quad (\text{SI: } 827.6 \, \text{nmol/L}) \\
\text{ACTH} & = 45 \, \text{pg/mL} \quad (10-65 \, \text{pg/mL}) \quad (\text{SI: } 9.9 \, \text{pmol/L} \ [2.2-14.3 \, \text{pmol/L}])
\end{align*}
\]

On the basis of these lab values, her primary care physician performed both pituitary and adrenal imaging. Pituitary MRI showed a possible 5-mm pituitary adenoma; however, the finding was small enough that confidence for an abnormality was low. Abdominal CT was also performed and demonstrated a 1.1-cm left adrenal adenoma.
Which of the following is the most appropriate next step?

A. Inferior petrosal sinus sampling
B. Transsphenoidal pituitary adenoma resection
C. Laparoscopic left-sided adrenalectomy
D. Late-night salivary cortisol testing
E. CT imaging of the chest

Correct Answer: D

Learning objective:
Evaluate for Cushing syndrome with late-night salivary cortisol measurement and recognize when dexamethasone suppression testing may not be accurate or reliable.
A 31-year-old woman was hospitalized after a motor vehicle hit her while she was crossing the street. She was previously healthy and was taking no medications before admission. She sustained pneumothorax, multiple rib fractures, and a femoral fracture. After initial stabilization, she underwent surgery to evacuate a right subdural hematoma. No sellar masses were noted on MRI. After initial resuscitation, her blood pressure was 112/75 mm Hg, pulse rate was 82 beats/min, and urine output was 90 to 120 cc/h. The patient is now somnolent but arousable and can follow simple commands. Her lungs are clear to auscultation. There is no peripheral edema. During the first postoperative week, she is noted to have persistent hyponatremia (serum sodium, 125-128 mEq/L [125-128 mmol/L]) without new findings on physical examination.

Laboratory test results:

- Serum sodium = 127 mEq/L (136-142 mEq/L) (SI: 127 mmol/L [136-142 mmol/L])
- Urinary sodium = 54 mEq/L (SI: 54 mmol/L)
- Urine osmolality = 440 mOsm/kg (150-1150 mOsm/kg) (SI: 440 mmol/kg [150-1150 mmol/kg])
- TSH = 0.6 mIU/L (0.5-5.0 mIU/L)
- Free T4 = 0.9 ng/dL (0.8-1.8 ng/dL) (SI: 11.6 pmol/L [10.30-23.17 pmol/L])
- Total T3 = 60 ng/dL (70-200 ng/dL) (SI: 0.9 nmol/L [1.08-3.08 nmol/L])
- Morning serum cortisol = 2.8 µg/dL (SI: 77.2 nmol/L) at baseline, rising to a peak cortisol level of 19 µg/dL (524.2 nmol/L) after cosyntropin administration (250 mcg)
Which of the following is the best next management step?

A. Administration of hydrocortisone in stress doses
B. Administration of levothyroxine
C. Fluid restriction
D. Administration of 3% saline
E. Administration of conivaptan

Correct Answer: A

Learning objective:
Diagnose and manage central hypoadrenalism occurring after traumatic brain injury.
ITE 2019 Question 89

A 27-year-old woman seeks evaluation for a 6-month history of amenorrhea, dyspareunia, vaginal dryness, and night sweats. She has a history of goiter, and a recent TSH measurement was 2.0 mIU/L. She is sexually active. Her family history is notable for her mother and maternal aunt having early menopause at age 39 years and 40 years, respectively. She has a 19-year-old brother with autism.

On physical examination, the thyroid is about twice normal size and she has atrophic vaginal lining on pelvic examination.

Laboratory test results:

- **FSH** = 90.0 mIU/mL (2.0-12.0 mIU/mL [follicular]; 4.0-36.0 mIU/mL [midcycle]; 1.0-9.0 mIU/mL [luteal]; >30 mIU/mL [postmenopausal]) (SI: 90.0 IU/L [2.0-12.0 IU/L (follicular); 4.0-36.0 IU/L (midcycle); 1.0-9.0 IU/L (luteal); >30 IU/L (postmenopausal)])
- **Estradiol** = 20 pg/mL (10-180 pg/mL [follicular]; 100-300 pg/mL [midcycle]; 40-200 pg/mL [luteal]; <20 pg/mL [postmenopausal]) (SI: 73.4 pmol/L [36.7-660.8 pmol/L (follicular); 367.1-1101.3 pmol/L (midcycle); 146.8-734.2 pmol/L (luteal); <73.4 pmol/L (postmenopausal)])
- **Progesterone** = 1.1 ng/mL (≤1.0 ng/mL) (SI: 3.5 nmol/L [<3.2 nmol/L])
- **Prolactin** = 7 ng/mL (4-30 ng/mL) (SI: 0.30 nmol/L [0.17-1.30 nmol/L])
- **Karyotype**: 46,XX
Which of the following tests is most likely to explain this patient’s clinical presentation?

A. Qualitative β-hCG
B. Measurement of ovarian antibodies
C. Measurement of TPO antibodies
D. Fragile X (FMR1) testing
E. Pituitary MRI

Correct Answer: D

Learning objective:
Explain the differential diagnosis of premature ovarian insufficiency and appropriately recommend fragile X carrier testing.
ITE 2019 Question 90

A 45-year-old man in the intensive care unit is found to have new-onset hypertriglyceridemia. He was admitted to the hospital 8 days ago with gallstone pancreatitis. Four days ago, his clinical course was complicated by respiratory failure requiring intubation and transfer to the intensive care unit. He developed an ileus and there is concern about pancreatic pseudocyst formation. As a result, enteral feedings have been deferred and he has been on central parenteral nutrition the past 3 days. This has been associated with some hyperglycemia currently managed with insulin infusion. He requires multiple intravenous medications provided in either saline or D5W riders. He also requires intravenous propofol as a sedative.

He has no history of diabetes or lipid abnormalities. His current central parenteral nutrition formula is providing 70% of basal calories as determined by the Harris Benedict equation with 1.5 g/kg of protein and 30% of calories from lipid emulsion.

On physical examination, he is sedated and intubated. He has a nasogastric tube for intermittent suction. His abdomen is distended with hypoactive bowel sounds. There are no peritoneal signs. His admission weight was 202 lb (91.8 kg) and height was 68.5 in (174 cm) (BMI = 30.3 kg/m2).
Laboratory test results:

- Sodium = 135 mEq/L (136-142 mEq/L) (SI: 135 mmol/L [136-142 mmol/L])
- Creatinine = 1.4 mg/dL (0.7-1.3 mg/dL) (SI: 123.8 µmol/L [61.9-114.9 µmol/L])
- Potassium = 3.2 mg/dL (3.5-5.0 mEq/L) (SI: 3.2 mEq/L [3.5-5.0 mmol/L])
- Triglycerides = 835 mg/dL (<150 mg/dL [optimal]) (SI: 9.44 mmol/L [<1.70 mmol/L])
- Free T4 = 0.6 ng/dL (0.8-1.8 ng/dL) (SI: 7.7 pmol/L [10.30-23.17 pmol/L])

Metered glucose values over the course of 6 hours have ranged from 125 mg/dL (6.9 mmol/L) to 137 mg/dL (7.6 mmol/L) His insulin infusion is stable at 2 units/h.
Which of the following is the best next step in the management of this patient’s hypertriglyceridemia?

A. Increase the rate of insulin infusion to maintain glucose levels between 80 and 110 mg/dL (4.4-6.1 mmol/L)
B. Change central parenteral nutrition to peripheral parenteral nutrition
C. Add a fibrate agent via the nasogastric tube
D. Stop the lipid emulsion in central parenteral nutrition; continue the dextrose–amino acid solution
E. Start intravenous levothyroxine

Correct Answer: D

Learning objective:
Identify factors that contribute to hypertriglyceridemia in patients receiving central parenteral nutrition.