MULTIPLE CHOICE

1. An anticholinergic that can be administered via aerosolization is
   a. ipratropium bromide.
   b. albuterol sulfate.
   c. glycopyrrolate.
   d. atropine.

   ANS: A
   Ipratropium is approved specifically for maintenance treatment of airflow obstruction in chronic obstructive pulmonary disease (COPD). Albuterol is not an anticholinergic; it is an adrenergic. Glycopyrrolate is not approved for inhalation. Atropine is not recommended for inhalation because of its widespread distribution in the body and the availability of the approved drug ipratropium bromide.

   REF: p. 123

2. The combination of albuterol and ipratropium bromide can be delivered by which of the following methods?
   1. Tablet
   2. Nebulizer
   3. Injection
   4. MDI
   5. Soft-mist inhaler

   a. 2 only
   b. 1, 3, and 4 only
   c. 1, 2, and 4 only
   d. 2, 4, and 5 only

   ANS: D
   Combivent is available in three formulations for bronchodilator use: as a hydrofluoroalkane propelled MDI (HFA MDI) with 17 µg/puff, as a nebulizer solution of 0.02% concentration in a 2.5-ml vial, giving a 500-µg dose per treatment, and as a softmist propellant-free Respimat inhaler.

   REF: p. 123
3. Incruse Ellipta is approved for
   a. exacerbation of chronic obstructive pulmonary disease (COPD).
   b. thinning of dried secretions.
   c. acute bronchoconstriction.

D maintenance treatment of airflow obstruction in COPD.
ANS: D
Umeclidinium (Incruse Ellipta) is a long-acting anticholinergic approved by the FDA for once-daily maintenance treatment of airflow obstruction in patients with COPD.
REF: p. 123

4. Combivent is a combination drug including which two medications?
   a. Albuterol and salmeterol
   b. Salmeterol and ipratropium bromide
   c. Albuterol and ipratropium bromide
   d. Pirbuterol and ipratropium bromide

ANS: C
Ipratropium and albuterol (Combivent) is a combination metered dose inhaler (MDI) product, with the usual doses of each agent (18 µg/puff of ipratropium, 90 µg/puff of albuterol).
REF: p. 123

5. Cholinergic stimulation produces which of the following effects?
   1. Bronchoconstriction
   2. Increased mucus secretion
   3. Miosis
   4. Decreased heart rate
   5. Salivation

   a. 4 only
   b. 1, 3, and 5 only
   c. 2, 3, and 4 only
   d. 1, 2, 3, 4, and 5

ANS: D
Cholinergic stimulation of muscarinic receptors on airway smooth muscle and submucosal glands causes contraction and release of mucus. Miosis, bradycardia, and salivation are also potential effects of cholinergic stimulation.
REF: p. 127

6. Mucociliary slowing, bronchodilation, and increased heart rate all are a result of a. cholinergic agents.
b. adrenergic agents.
c. anticholinergic agents.
d. parasympathetic agents.

ANS: C
Cholinergic agents decrease the heart rate, cause bronchoconstriction, and induce mucus secretion. Adrenergic agents do not cause mucociliary slowing. Anticholinergic agents block parasympathetic tone and may cause mucociliary slowing, bronchodilation, and increased heart rate. Parasympathetic agents decrease heart rate and cause bronchoconstriction.

REF: p. 127

7. Quaternary ammonium compounds such as ipratropium bromide
   a. are ineffective as inhaled agents.
   b. do not cross lipid membranes easily.
   c. are distributed quickly throughout the body when inhaled.
   d. have no role in respiratory care.

ANS: B
Quaternary ammonium compounds are effective when inhaled (e.g., Atrovent). Generally, quaternary ammonium compounds do not cross lipid membranes easily and do not distribute throughout the body when inhaled. Atrovent is used frequently in respiratory care.

REF: p. 127

8. Ipratropium bromide is indicated to treat which of the following?
   a. Allergic rhinitis
   b. Maintenance therapy in patients with COPD
   c. Nonallergic rhinitis
   d. All of the above

ANS: D
Ipratropium bromide is approved specifically for maintenance treatment of airflow obstruction in chronic obstructive pulmonary disease (COPD). Ipratropium bromide (Atrovent nasal spray) is also available for treatment of rhinopathies and rhinorrhea, including nonallergic perennial rhinitis, viral infectious rhinitis (colds), and allergic rhinitis, if intranasal corticosteroids fail to control symptoms.

REF: p. 123

9. Quaternary ammonium compounds cause bronchodilation by
   a. blocking cholinergic sites.
   b. stimulating cholinergic sites.
   c. blocking adrenergic sites.
   d. stimulating adrenergic sites.

ANS: A
Quaternary ammonium compounds cause bronchodilation by blocking cholinergic contractile action. In the nasal passages, ipratropium reduces hypersecretion, the basis for its use in rhinitis. As an anticholinergic, the compound would not stimulate cholinergic sites. Quaternary ammonium compounds do not act on adrenergic sites.

REF: p. 128 | p. 129

10. Patients using ipratropium aerosols should be instructed to avoid allowing the aerosol to come in contact with their
   a. hair.
   b. nose.
   c. eyes.
   d. ears.

   ANS: C

   Ipratropium nasal spray is useful in various respiratory disorders, but it may cause pupillary dilation and lens paralysis. Ipratropium has no known effect on human hair or the human ear.

   REF: p. 131

11. Activating an Atrovent inhaler in the eye may cause
   a. blindness.
   b. pupil dilation.
   c. pupil constriction.
   d. scarring of the cornea.

   ANS: B

   Pupillary dilation and lens paralysis may result, not total blindness. Corneal scarring is not a known risk factor.

   REF: p. 131 | p. 132

12. Cardiac effects of aerosolized ipratropium bromide include which of the following? a. Increased heart rate
   b. Increased blood pressure
   c. Increased heart muscle contractility
   d. Little or no effect

   ANS: D

   Ipratropium bromide has minimal effects on heart rate or blood pressure when given by inhaled aerosol. However, several more recent meta-analyses have suggested that ipratropium and tiotropium may cause an increase in cardiovascular events. When other meta-analyses were conducted and reexamined, no incidence of cardiovascular involvement from inhaled anticholinergics was found. Currently, no information has been conclusive in showing that these agents have any adverse effects on the cardiovascular system.

   REF: p. 131
13. Drugs that competitively block the action of acetylcholine at parasympathetic postganglionic effector cell receptors are called
   a. muscarinic agents.
   b. adrenergic agents.
   c. antimuscarinic agents.
   d. cholinergic agents.

   ANS: C

   Anticholinergic bronchodilators are specifically *parasympatholytic*, that is, *antimuscarinic*, agents, blocking the effect of acetylcholine at the cholinergic (muscarinic) receptors on bronchial smooth muscle. Adrenergic agents initiate a sympathomimetic action. Cholinergic agents would initiate an action at the effector cell receptor.

   REF: p. 126 | p. 127

14. The most common side effect of anticholinergic bronchodilators is
   a. dry mouth.
   b. increased heart rate.
   c. wheezing.
   d. delirium.

   ANS: A

   The most common side effect seen with this class of bronchodilator is dry mouth.

   REF: p. 131

15. Possible side effects of aerosolized Atrovent include which of the following?
   1. Flulike symptoms
   2. Pharyngitis
   3. Bradycardia
   4. Dry mouth
   5. Dyspnea

   a. 1, 2, and 3 only
   b. 1, 2, and 4 only
   c. 1, 2, 4, and 5 only
   d. 1, 2, 3, 4, and 5

   ANS: C

   The most common side effect seen with this class of bronchodilator is dry mouth. The small volume nebulizer (SVN) solution has also been associated with additional side effects in a few patients, including pharyngitis, dyspnea, flulike symptoms, bronchitis, and upper respiratory infection. Bradycardia is not a potential side effect of aerosolized Atrovent.

   REF: p. 131
16. Results of a patient’s pulmonary function test (PFT) show that the peak flow rate increased the most when she inhaled an aerosolized sympathomimetic agent and an aerosolized parasympatholytic agent. You would recommend that she be given which of the following?
   a. Ventolin MDI ®
   b. Serevent Diskus DPI ®
   c. Combivent Respimat ®
   d. Foradil DPI

ANS: C

Ventolin MDI, Serevent Diskus, and Foradil are sympathomimetic agents only.

Combivent Respimat is a combination sympathomimetic (albuterol) and parasympatholytic (ipratropium bromide).

REF: p. 132 | p. 133

17. Which of the following is a once-a-day anticholinergic?
   a. Atropine
   b. Ipratropium bromide
   c. Glycopyrrolate
   d. Umeclidinium bromide

ANS: D

If used as an inhaled drug, atropine sulfate must be administered several times daily. Ipratropium bromide has a duration of only 4 to 6 hours. Glycopyrrolate is a quaternary ammonium derivative of atropine that, similar to ipratropium, does not distribute well across lipid membranes in the body. It is usually administered parenterally as an antimuscarinic agent during reversal of neuromuscular blockade, as an alternative to atropine, with fewer ocular or central nervous system side effects. It has a duration of approximately 6 hours. Umeclidinium bromide (Incruse Ellipta) has a duration of up to 24 hours and needs to be administered only once daily.

REF: p. 123

18. Which of the following statements regarding ipratropium bromide are true?
   1. It is a first-line choice of bronchodilator for chronic obstructive pulmonary disease (COPD).
   2. It can be combined with a □ agonist for maintenance bronchodilation in COPD.
   3. It is added to a □ agonist in severe asthma episodes that do not respond to a □ agonist alone.
   4. It is a leukotriene modifier used to treat step 3 asthma.

   a. 1 and 4 only
   b. 2 and 4 only
c. 1, 2, and 4 only
d. 1, 2, and 3 only

ANS: D
agonists and anticholinergic agents may have an additive effect when used to combat COPD. Ipratropium bromide is an anticholinergic (parasympatholytic) drug, not a leukotriene modifier.

REF: p. 132 | p. 133

19. Tiotropium bromide exhibits receptor subtype selectivity for which of the following receptor types?
   a. M1 only
   b. M2 only
   c. M1, M2, and M3
   d. M1 and M3

ANS: D
Tiotropium exhibits receptor subtype selectivity for M1 and M3 receptors. The drug binds to all three muscarinic receptors (M1, M2, and M3) but dissociates much more slowly than ipratropium from the M1 and M3 receptors; this results in a selectivity of action on M1 and M3 receptors.

REF: p. 129 | p. 130

20. Which of the following patient populations may benefit from anticholinergic agents?
   a. Patients experiencing acute, severe episodes of asthma not responding well to agonists
   b. Patients with psychogenic asthma
   c. Patients with nocturnal asthma
   d. All of the above

ANS: D
Anticholinergic (antimuscarinic) agents such as ipratropium do not have a labeled indication for asthma in the United States. Current asthma guidelines state that ipratropium may have some additive benefit when given with inhaled agonists. Antimuscarinic bronchodilators are not clearly superior to- adrenergic agents in treating asthma. Antimuscarinic and -adrenergic agents have an approximately equal effect on flow rates in many patients. These agents may be especially useful in the following asthmatic patients: patients with nocturnal asthma, in which the slightly longer duration of action may protect against nocturnal deterioration of flow rates; patients with psychogenic asthma, which may be mediated through vagal parasympathetic fibers; asthmatic patients with glaucoma, angina, or hypertension who require treatment with -blocking agents; patients with notable side effects from theophylline as an alternative to theophylline; and patients with acute, severe episodes of asthma not responding well to agonists.

REF: p. 132 | p. 133

21. Which of the following is a term used to describe an agent that produces the effect of acetylcholine or an agent that mimics acetylcholine?
ANS: C
Muscarinic (same as cholinergic) refers to an agent that produces the effect of acetylcholine or an agent that mimics acetylcholine.
Parasympatholytic refers to an agent that blocks parasympathetic nervous fibers.
Parasympathomimetic refers to an agent that produces effects similar to the parasympathetic nervous system.
Antimuscarinic bronchodilator (same as anticholinergic bronchodilator) refers to an agent that blocks the effect of acetylcholine at the cholinergic site.

REF: p. 122

22. Acetylcholine stimulates M3 receptors on airway smooth muscle, causing which of the following?
   a. Bronchodilation
   b. Bronchoconstriction
   c. Decrease in mucous gland secretion
   d. There are no M3 receptors in the airway.

ANS: B
Acetylcholine stimulates M3 receptor subtypes on airway smooth muscle and submucosal glands, causing contraction of smooth muscle and exocytosis of secretion from the mucous gland.

REF: p. 129 | p. 130

23. Which of the following is the generic name for Atrovent? a. Aclidinium bromide
   b. Tiotropium bromide
   c. Ipratropium bromide
   d. Umeclidinium bromide

ANS: C

<table>
<thead>
<tr>
<th>DRUG</th>
<th>BRAND NAME</th>
<th>ADULT DOSAGE</th>
<th>TIME COURSE (ONSET, PEAK, DURATION)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ipratropium</td>
<td>Atrovent HFA</td>
<td>HFA MDI: 17 μg/puff. 2 puffs qid. SVN: 0.02% solution (0.2 mg/mL). 500 μg tid, qid. Nasal spray: 21 μg; 42 μg; 2 sprays per nostril 2 to 4 times daily (dosage varies)</td>
<td>Onset: 15-30 min. Peak: 1-2 hr. Duration: 6 hr</td>
</tr>
<tr>
<td>Ipratropium</td>
<td>Combivent</td>
<td>SMI: ipratropium 20 μg/puff</td>
<td>Onset: 15 min</td>
</tr>
<tr>
<td>DRUG</td>
<td>BRAND NAME</td>
<td>ADULT DOSAGE</td>
<td>TIME COURSE (ONSET, PEAK, DURATION)</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>----------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Ipratropium bromide</td>
<td>Atrovent HFA</td>
<td>HFA MDI: 17 g/puff, 2 puffs qid</td>
<td>Onset: 15-30 min</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SVN: 0.02% solution (0.2 mg/mL), 500 g tid, qid</td>
<td>Peak: 1-2 hr</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nasal spray: 21 g; 42 g; 2 sprays per nostril 2 to 4 times daily (dosage varies)</td>
<td>Duration: 6 hr</td>
</tr>
<tr>
<td>Ipratropium bromide and albuterol</td>
<td>Combivent</td>
<td>SMI: ipratropium 20 g/puff and albuterol 100 g/puff, 1 inhalation qid</td>
<td>Onset: 15 min</td>
</tr>
<tr>
<td></td>
<td>Respimat</td>
<td></td>
<td>Peak: 1-2 hr</td>
</tr>
<tr>
<td></td>
<td>DuoNeb</td>
<td>SVN: ipratropium 0.5 mg and albuterol 2.5 mg</td>
<td>Duration: 6 hr</td>
</tr>
<tr>
<td>Aclidinium bromide</td>
<td>Tudorza Pressair</td>
<td>DPI: 400 g/inhalation, 1 inhalation bid</td>
<td>Onset: 10 min</td>
</tr>
<tr>
<td>Tiotropium bromide</td>
<td>Spiriva</td>
<td>DPI: 18 g/inhalation, 1 inhalation daily (one capsule)</td>
<td>Peak: 2 hr</td>
</tr>
<tr>
<td>Umeclidinium bromide</td>
<td>Incruse Ellipta</td>
<td>DPI: 62.5 g/inhalation, 1 inhalation daily</td>
<td>Onset: 5-15 min</td>
</tr>
<tr>
<td>Umeclidinium bromide and vilanterol</td>
<td>Anoro Ellipta</td>
<td>DPI: umeclidinium 62.5 g/inhalation and vilanterol 25 g/inhalation, 1 inhalation daily</td>
<td>Onset: 5-15 min</td>
</tr>
</tbody>
</table>

REF: p. 123

24. Which of the following is the generic name for Incruse Ellipta?
   a. Aclidinium bromide
   b. Tiotropium bromide
   c. Ipratropium bromide
   d. Umeclidinium bromide

ANS: D
bromide | inhalation daily (one capsule) | Peak: 1-3 hr Duration: 24 hr
---|---|---
Umeclidinium bromide | Incruse Ellipta | DPI: 62.5 \( \text{g/inhalation}, 1 \) inhalation daily | Onset: 5-15 min Peak: 1-3 hr Duration: 24 hr
Umeclidinium Bromide and vilanterol | Anoro Ellipta | DPI: umeclidinium 62.5 \( \text{g/inhalation and vilanterol} \) 25 \( \text{g/inhalation}, 1 \) inhalation daily | Onset: 5-15 min Peak: 1-3 hr Duration: 24 hr

REF: p. 123

25. Which of the following is the generic name for Spiriva?
   a. Aclidinium bromide
   b. Tiotropium bromide
   c. Ipratropium bromide
   d. Umeclidinium bromide

ANS: B

<table>
<thead>
<tr>
<th>DRUG</th>
<th>BRAND NAME</th>
<th>ADULT DOSAGE</th>
<th>TIME COURSE (ONSET, PEAK, DURATION)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ipratropium bromide</td>
<td>Atrovent HFA</td>
<td>HFA MDI: 17 ( \text{g/puff} ), 2 puffs qid SVN: 0.02% solution (0.2 mg/mL), 500 ( \text{g} ) tid, qid Nasal spray: 21 ( \text{g} ), 42 ( \text{g} ); 2 sprays per nostril 2 to 4 times daily (dosage varies)</td>
<td>Onset: 15-30 min Peak: 1-2 hr Duration: 6 hr</td>
</tr>
<tr>
<td>Ipratropium bromide and albuterol</td>
<td>Combivent Respimat</td>
<td>SMI: ipratropium 20 ( \text{g/puff} ) and albuterol 100 ( \text{g/puff} ); 1 inhalation qid</td>
<td>Onset: 15 min Peak: 1-2 hr Duration: 6 hr</td>
</tr>
<tr>
<td></td>
<td>DuoNeb</td>
<td>SVN: ipratropium 0.5 mg and albuterol 2.5 mg</td>
<td></td>
</tr>
<tr>
<td>Aclidinium</td>
<td>Tudorza Pressair</td>
<td>DPI: 400 ( \text{g/inhalation} ), 1</td>
<td>Onset: 10 min</td>
</tr>
</tbody>
</table>

bromide | inhalation bid | Peak: 2 hr Duration: 12
---|---|---
Tiotropium bromide | Spiriva | DPI: 18 \( \text{g/inhalation}, 1 \) inhalation daily (one capsule) | Onset: 30 min Peak: 1-3 hr Duration: 24 hr
Umeclidinium bromide | Incruse Ellipta | DPI: 62.5 \( \text{g/inhalation}, 1 \) inhalation daily | Onset: 5-15 min Peak: 1-3 hr Duration: 24 hr
Umeclidinium Bromide and Vilanterol | Anoro Ellipta | DPI: umeclidinium 62.5 \( \text{g/inhalation and vilanterol} \) | Onset: 5-15 min Peak: 1-3 hr |
vilanterol | 25 g/inhalation, 1 inhalation daily | Duration: 24 hr

REF: p. 123

26. Which of the following is the generic name for Tudorza Pressair?
   a. Aclidinium bromide
   b. Tiotropium bromide
   c. Ipratropium bromide
   d. Umeclidinium bromide

ANS: A

<table>
<thead>
<tr>
<th>DRUG</th>
<th>BRAND NAME</th>
<th>ADULT DOSAGE</th>
<th>TIME COURSE (ONSET, PEAK, DURATION)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ipratropium bromide</td>
<td>Atrovent HFA</td>
<td>HFA MDI: 17 g/puff. 2 puffs qid</td>
<td>Onset: 15-30 min</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SVN: 0.02% solution (0.2 mg/mL), 500 g tid, qid</td>
<td>Peak: 1-2 hr</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nasal spray: 21 g; 42 g; 2 sprays per nostril 2 to 4 times daily (dosage varies)</td>
<td>Duration: 6 hr</td>
</tr>
<tr>
<td>Ipratropium bromide and albuterol</td>
<td>Combivent</td>
<td>SMI: ipratropium 20 g/puff and albuterol 100 g/puff, 1 inhalation qid</td>
<td>Onset: 15 min</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Peak: 1-2 hr</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Duration: 6 hr</td>
</tr>
<tr>
<td></td>
<td>Respimat</td>
<td>SVN: ipratropium 0.5 mg and albuterol 2.5 mg</td>
<td></td>
</tr>
<tr>
<td>Aclidinium bromide</td>
<td>Tudorza Pressair</td>
<td>DPI: 400 g/inhalation, 1 inhalation bid</td>
<td>Onset: 10 min</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Peak: 2 hr</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Duration: 12</td>
</tr>
<tr>
<td>Tiotropium bromide</td>
<td>Spiriva</td>
<td>DPI: 18 g/inhalation, 1 inhalation daily (one capsule)</td>
<td>Onset: 30 min</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Peak: 1-3 hr</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Duration: 24 hr</td>
</tr>
<tr>
<td>Umeclidinium bromide</td>
<td>Incruse Ellipta</td>
<td>DPI: 62.5 g/inhalation, 1 inhalation daily</td>
<td>Onset: 5-15 min</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Peak: 1-3 hr</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Duration: 24 hr</td>
</tr>
<tr>
<td>Umeclidinium Bromide and vilanterol</td>
<td>Anoro Ellipta</td>
<td>DPI: umeclidinium 62.5 g/inhalation and vilanterol</td>
<td>Onset: 5-15 min</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Peak: 1-3 hr</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Duration: 24 hr</td>
</tr>
</tbody>
</table>

REF: p. 123