Drugs Acting on the Lower Respiratory Tract

55

Learning Objectives

Upon completion of this chapter, you will be able to:

1. Describe the underlying pathophysiology involved in obstructive pulmonary disease and correlate this information with the presenting signs and symptoms.
2. Describe the therapeutic actions, indications, pharmacokinetics, contraindications, most common adverse reactions, and important drug–drug interactions associated with drugs used to treat lower respiratory tract disorders.
3. Discuss the use of drugs used to treat obstructive pulmonary disorders across the lifespan.
4. Compare and contrast the prototype drugs used to treat obstructive pulmonary disorders with other agents in their class and with other classes of drugs used to treat obstructive pulmonary disorders.
5. Outline the nursing considerations, including important teaching points, for patients receiving drugs used to treat obstructive pulmonary disorders.

Glossary of Key Terms

bronchodilator: medication used to facilitate respirations by dilating the airways; helpful in symptomatic relief or prevention of bronchial asthma and bronchospasm associated with chronic obstructive pulmonary disease

Cheyne–Stokes respiration: abnormal pattern of breathing characterized by apneic periods followed by periods of tachypnea; may reflect delayed blood flow t ough the brain

leukotriene receptor antagonists: drugs that selectively and competitively block or antagonize receptors for the production of leukotrienes D_4 and E_4, components of slow-reacting substance of anaphylaxis (SRSA)

mast cell stabilizer: drug that works at the cellular level to inhibit the release of histamine (released from mast cells in response to inflammation or irritation) and the elease of slow-reacting substance of anaphylaxis (SRSA)

sympathomimetics: drugs that mimic the effects of the sympathetic nervous system

xanthines: naturally occurring substances, including caffeine and theophylline, that have a direct effect on the smooth muscle of the respiratory tract, both in the bronchi and in the blood vessels

BRONCHODILATORS/ ANTIASTHMATICS

Xanthines
- (P) aminophylline
- caffeine
- dyphylline
- theophylline

Sympathomimetics
- albuterol
- arformoterol
- ephedrine
- (P) epinephrine
- formoterol
- isoetharine
- isoproterenol
- levalbuterol
- metaproterenol
- pirbuterol
- salmeterol
- terbutaline

Anticholinergics
- (P) ipratropium
- tiotropium

DRUGS AFFECTING INFLAMMATION

Inhaled Steroids
- beclomethasone
- (P) budesonide
- ciclesonide
- fluticasone
- triamcinolone

Leukotriene Receptor Antagonists
- montelukast
- (P) zafirlukast
- zileuton

Mast Cell Stabilizer
- (P) cromolyn

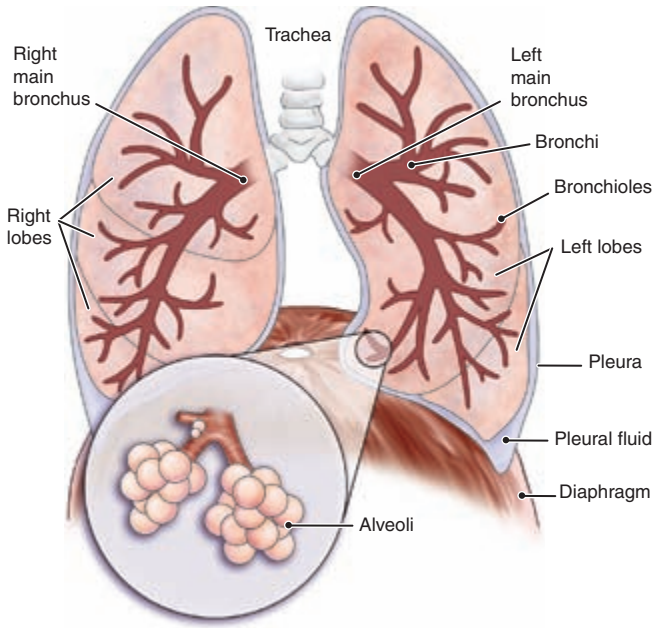
LUNG SURFACTANTS
- (P) beractant
- calfactant
- poractant

The lower respiratory tract includes the bronchial tree and the alveoli, where gas exchange occurs (see Figure 55.1). Disorders of the lower respiratory tract can have a direct impact on gas exchange and oxygenation and can include infections such as bronchiectasis, bronchitis, and pneumonia and obstructive disorders that directly interfere with airflow to the alveoli.

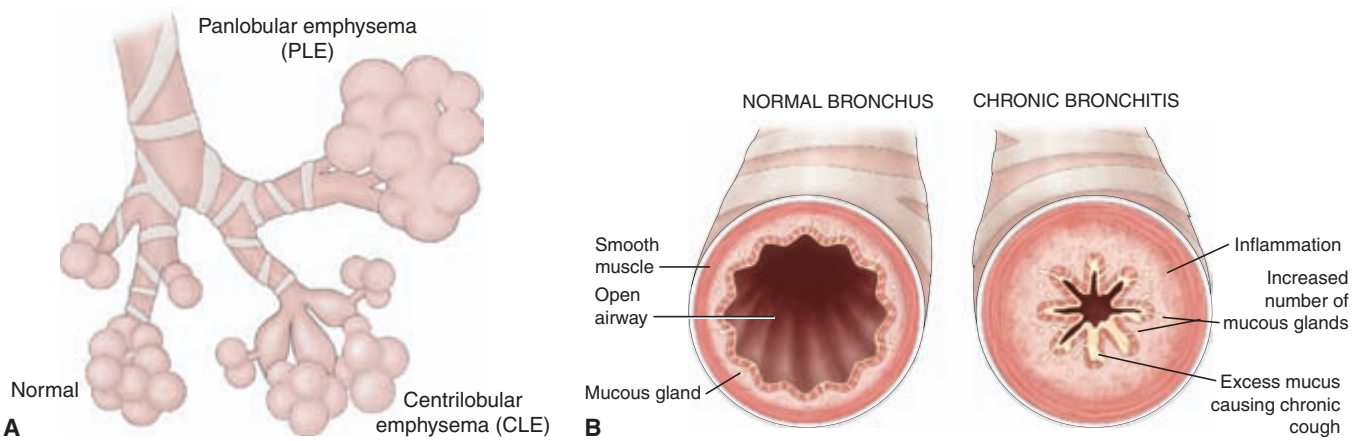
Pulmonary obstructive diseases include asthma and chronic obstructive pulmonary disease (COPD), which includes emphysema. (See Chapter 53 for detailed pathophysiology.) These diseases cause obstruction of the major airways and may lead to complications such as infections, pneumonia, and movement of inhaled substances deep into the respiratory system. The obstruction of asthma, emphysema, and COPD can be related to inflammation that result in narrowing of the interior of the airway and to muscular constriction that results in narrowing of the conducting tube (Figure 55.2). With chronic inflammation muscular and ciliial action is lost, and complications related to the loss of these protective processes can occur, such as infections, pneumonia, and movement of inhaled substances deep into the respiratory system. In severe COPD, air is trapped in the lower respiratory tract, the alveoli degenerate and fuse together, and the exchange of gases is greatly impaired.

The first step for treatment includes reducing environmental exposure to irritants such as stopping smoking, filtering allergens from the air, and avoiding exposure to known irritants and allergens. If these efforts are not sufficient to prevent problems, treatment is aimed at either opening the conducting airways through muscular bronchodilation or decreasing the effects of inflammation on the lining of the airway. See Table 55.1 for guidelines for maintenance treatment of asthma.

Additional obstructive pulmonary diseases are respiratory distress syndrome (RDS), which causes obstruction at the alveolar level, and adult respiratory distress syndrome (ARDS), which is characterized by progressive loss of lung compliance and increasing hypoxia. This syndrome occurs as a result of a severe insult to the body, such as cardiovascular collapse, major burns, severe trauma, and rapid depressurization. The obstruction of RDS in the neonate is related to a lack of the lipoprotein surfactant, which leads to an inability to maintain an open alveolus. Surfactant is essential in decreasing the surface tension in the tiny alveolus, allowing it to expand and remain open. If surfactant is lacking, the alveoli collapse and gas exchange cannot occur. Pharmacological therapy for RDS involves instilling surfactant into the alveoli. Treatment of ARDS involves reversal of the underlying cause of the problem combined with ventilatory support. See Box



● FIGURE 55.1 The lower respiratory tract.



● FIGURE 55.2 Changes in the airways with chronic obstructive pulmonary disease.

TABLE 55.1 Guidelines for Maintenance Treatment of Asthma*

TREATMENT	INTERMITTENT ASTHMA (symptoms less than once a week, no symptoms between attacks)		MILD PERSISTENT ASTHMA (symptoms at least once a week but less than once a day)		MODERATE PERSISTENT ASTHMA (daily symptoms and treatment, attacks affect activities)		SEVERE ASTHMA (continuous symptoms, limited physical activity, frequent exacerbations)	
	Prevention	Acute	Prevention	Acute	Prevention	Acute	Prevention	Acute
Short-acting inhaled beta-agonist†				X		X		X
Inhaled corticosteroids†					X		X	
Mast cell stabilizer			X‡					
Leukotriene-receptor agonist			X					
Long-acting bronchodilators							X	
Inhaled beta-agonists†								
Sustained-release theophylline			§					
Long-acting oral beta-agonist								
Corticosteroids							X‖	

*Effective treatment depends on patient response; a combination of therapies may be required to achieve good control. †Considered drug of choice. ‡May be preferred treatment in children >2 yr. §Not a preferred treatment. ‖Wean to inhaled preparation as soon as possible.

55.1 for the use of lower respiratory tract agents with different age groups.

BRONCHODILATORS/ANTIASTHMATICS

Bronchodilators (Table 55.2), or antiasthmatics, are medications used to facilitate respirations by dilating the airways. They are helpful in symptomatic relief or prevention of bronchial asthma and for bronchospasm associated with COPD. Several of the bronchodilators are administered orally and absorbed systemically, giving them the potential for many systemic adverse effects. Other medications are administered directly into the airways by nebulizers. These medications have the advantage of fewer systemic adverse reactions. Bronchodilators include xanthines, sympathomimetics, and anticholinergics. A new type of drug used to treat alpha$_1$-protease deficiency, *Zemaira*, is discussed in Box 55.2.

Xanthines

The **xanthines,** including caffeine and theophylline, come from a variety of naturally occurring sources. These drugs were once the main treatment choices for asthma and bronchospasm. However, because they have a relatively narrow margin of safety and interact with many other drugs, they are no longer considered the first-choice bronchodilators. Xanthines used to treat respiratory disease include aminophylline (*Truphylline*), caffeine (*Caffedrine* and others), dyphylline (*Dilor* and others), and theophylline (*Slo-Bid*, *Theo-Dur*).

Therapeutic Actions and Indications

The xanthines have a direct effect on the smooth muscles of the respiratory tract, both in the bronchi and in the blood vessels (Figure 55.3). Although the exact mechanism of action is not known, one theory suggests that xanthines work by directly affecting the mobilization of calcium within the cell. They do this by stimulating two prostaglandins, resulting in smooth muscle relaxation, which increases the vital capacity that has been impaired by bronchospasm or air trapping. Xanthines also inhibit the release of slow-reacting substance of anaphylaxis (SRSA) and histamine, decreasing the bronchial swelling and narrowing that occurs as a result of these two chemicals. See Table 55.2 for usual indications for these drugs. Unlabeled uses include stimulation of respirations in **Cheyne–Stokes respiration,** an abnormal pattern of breath-

FOCUS ON

BOX 55.1 Drug Therapy Across the Lifespan

Lower Respiratory Tract Agents

Children

Antiasthmatics are frequently used in children. The incidence of asthma in children has been rapidly increasing in the 21st century. The leukotriene-receptor antagonists have been found to be especially effective for long-term prophylaxis in children. Acute episodes are best treated with a beta-agonist and then a long-acting inhaled steroid or a mast cell stabilizer.

Parents need to be encouraged to take measures to prevent acute attacks, including avoidance of known allergens, smoke-filled rooms, an crowded or dusty areas. Parents should be cautioned about the proper way to measure liquid preparations to avoid inadvertent toxic doses or lack of therapeutic effects.

Theophylline has been used in children, but because of its many adverse effects and the better control afforded by newer agents, its use is reserved for cases that do not respond to other therapies.

As the child grows and matures, the disease will need to be re-evaluated and dose adjustments made to meet the needs of the growing child. Teenagers need to learn the proper administration and use of inhaled steroids for prevention of exercise-induced asthma.

As with other classes of medications, children may be more susceptible to the adverse effects associated with these drugs and need to be carefully monitored and evaluated. Over-the-counter (OTC) drugs and herbal remedies should be avoided if possible; if they are used, they should be reported to the health care provider so that appropriate dose adjustments can be made where needed.

The parents of premature babies undergoing surfactant therapy will require consistent support and education to help them to cope with the stress of this event.

Adults

Adults may be able to manage their asthma quite well with the use of inhalers and avoidance of aggravating situations. Periodic review of the proper use of the various inhalers should be part of routine evaluation of these patients. Periodic spirometry readings should be done to evaluate the effectiveness of the therapy.

The safety of these drugs during pregnancy and lactation has not been established. There is a potential for adverse effects on the fetus related to blood flow changes an direct drug effects when the drugs cross the placenta. Use should be reserved for those situations in which the benefit t the mother outweighs the potential risk to the fetus. The drugs may enter breast milk and also may alter fluid balanc and milk production. It is advised that caution be used if one of these drugs is prescribed during lactation.

Older Adults

Older adults frequently are prescribed one or more of these drugs. Older adults are more likely to develop adverse effects associated with the use of these drugs, such as sedation, confusion, dizziness, urinary retention, and cardiovascular effects. Safety measures may be needed if these effects occur and interfere with the patient's mobility and balance.

Older adults are also more likely to have renal and/or hepatic impairment related to underlying medical conditions, which could interfere with the metabolism and excretion of these drugs. The dose for older adults should be started at a lower level than that recommended for young adults. Patients should be monitored very closely and dose adjustment made based on patient response.

These patients also need to be alerted to the potential for toxic effects when using OTC preparations and should be advised to check with their health care provider before beginning any OTC drug regimen. Older adults with progressive chronic obstructive pulmonary disease may be taking many combined drugs to help them maintain effective respirations. These patients should have an overall treatment plan involving complex pulmonary toilet, positioning, fluids, nutrition, humidi fied ai , rest, and activity plans, as well as a complicated drug regimen to deal with the impact of this disease.

BOX 55.2 Enzyme Therapy: Alpha$_1$-Protease Inhibitor (Human)

An alpha$_1$-protease inhibitor, *Zemaira,* was approved in 2003 for the treatment of alpha$_1$-protease deficien y, a chronic, hereditary, autosomal dominant disorder that presents as progressive, severe emphysema, usually during a person's 30s or 40s. Alpha$_1$-protease inhibitor is normally present in the lungs and acts to neutralize neutrophil elastase, which is increased by smoking or lung infection. Patients who do not produce enough alpha$_1$-protease inhibitor are at risk for progressive lung tissue destruction with smoking or lung infection. This type of emphysema and COPD does not respond well to the drug therapy usually associated with COPD. *Zemaira* is infused during a period of 15 minutes once each week at a dose of 60 mg/kg and provides protection from tissue destruction.

ing characterized by apneic periods follo wed by periods of tachypnea that may reflect delayed blood f w through the brain, and the treatment of apnea and bradycardia in premature infants.

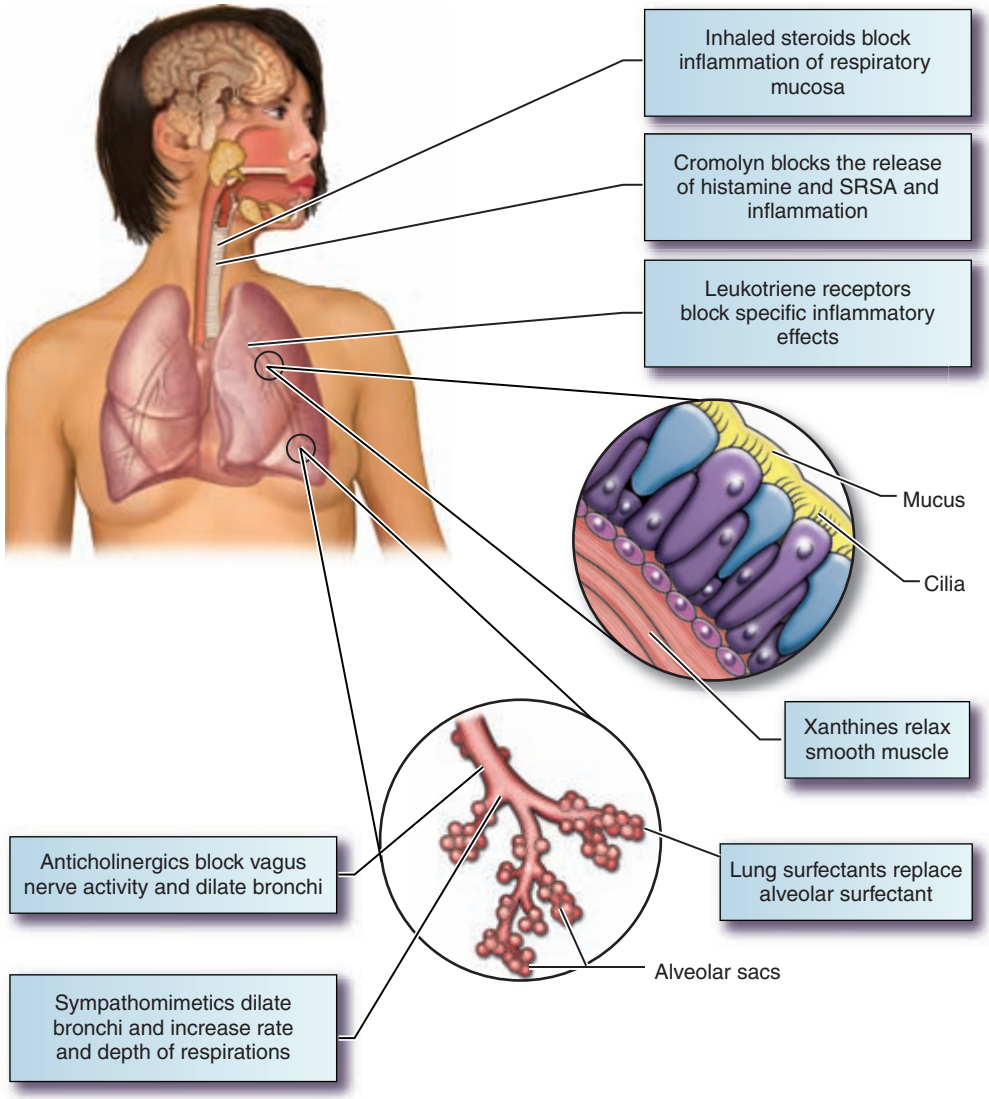
Pharmacokinetics

The xanthines are rapidly absorbed from the gastrointestinal (GI) tract when given orally, reaching peak levels within 2 hours. They are also gi ven IV , reaching peak ef fects within minutes. They are widely distrib uted and metabolized in the liver and excreted in urine. Xanthines cross the placenta and enter breast milk (see Contraindications and Cautions).

TABLE 55.2 DRUGS IN FOCUS Bronchodilators/Antiasthmatics

Drug Name	Usual Dosage	Usual Indications
Xanthines		
aminophylline (*Truphylline*)	Adult: 6 mg/kg PO loading dose, then 3.8 mg/kg q4h × three doses; maintenance: 3 mg/kg q6h Range: 600–1,600 mg/d PO in three to four divided doses Rectal: 500 mg q6–8h IV emergency use: 1 mg/kg per hour for the first 12 h after a loading dose of 0.6–3.2 mg/kg based on theophylline levels; 0.8 mg/kg per hour should be used after 12 h of therapy Geriatric, renal or hepatic impaired patient: reduce dose and monitor closely Pediatric: 6 mg/kg PO loading dose, then 4 mg/kg (6 mo–9 yr) or 3 mg/kg (9–16 yr) q4h for three doses, then maintain at same dose q6h Range: 12 mg/kg per day PO IV emergency use: after a loading dose, administer 1.2 mg/kg per hour for children 6 mo–9 yr, or 1 mg/kg per hour for children 9–16 yr; if continued after 12 h, reduce dose to 1 mg/kg per hour (6 mo–9 yr) or 0.8 mg/kg per hour (9–16 yr) Base all doses on patient response and serum levels	Relief of symptoms or prevention of bronchial asthma and reversal of bronchospasm associated with COPD
caffeine (generic)	Adult: 500–1000 mg IM, do not exceed 2.5 g/d Pediatric: 10 mg/kg IV followed by 2.5 mg/kg per day for neonatal apnea	Relief of symptoms or prevention of bronchial asthma and reversal of bronchospasm associated with COPD
dyphylline (*Dilor*)	Adult: up to 15 mg/kg PO q.i.d. or 250–500 mg injected slowly IM Geriatric or impaired adult: use caution	Relief of symptoms or prevention of bronchial asthma and reversal of bronchospasm associated with COPD
theophylline (*Slo-Bid*, *Theo-Dur*)	Dosage varies widely, based on preparation and patient response Adult: 6 mg/kg PO loading dose followed by 3 mg/kg PO q4h × three doses, then 3 mg/kg PO q6h Chronic therapy: 400 mg/d PO in divided doses Rectal: 500 mg q6–8h IV emergency use: 4.7 mg/kg IV loading dose followed by oral therapy Pediatric: 6 mg/kg PO loading dose, then 4 mg/kg (6 mo–9 yr) or 3 mg/kg (9–16 yr) PO q4h × three doses, then the same dose q6h Chronic therapy: 400 mg/d PO in divided doses	Relief of symptoms or prevention of bronchial asthma and reversal of bronchospasm associated with COPD
Sympathomimetics		
albuterol (*Proventil*)	Adult: 2–4 mg PO t.i.d. to q.i.d. *or* two inhalations q4–6h *or* two inhalations 15 min before exercise Pediatric: >12 yr: adult dose 6–12 yr: 2 mg t.i.d. to q.i.d. oral tablets 6–14 yr: 2 mg t.i.d. to q.i.d. PO oral syrup 2–6 yr: 0.1 mg/kg PO t.i.d. oral syrup 2–12 yr (inhalation):1.25–2.5 mg; for prevention of exercise-induced bronchospasm, 200-mcg capsule inhaled 15 min before exercise	Long-acting treatment and prophylaxis of bronchospasm and prevention of exercise-induced bronchospasm in patients 2 yr and older
arformoterol *(Brovana)*	Adults: 15 mcg b.i.d. by nebulization	Long-term maintenance treatment of bronchoconstriction in COPD
ephedrine (generic)	Adult: 25–50 mg IM, SQ, or IV Pediatric: 25–100 mg/m^2 IM or SQ divided into four to six doses	Treatment of acute bronchospasm in adults and children, although epinephrine is the drug of choice

Drug Name	Usual Dosage	Usual Indications
***Sympathomimetics* (continued)**		
epinephrine (*Sus-Phrine*)	Adult: 0.1–0.3 mL SQ q20min for 4 h as needed; may also be given by aerosol inhalation or nebulization Pediatric: 0.01–0.3 mL/m^2 SQ q20min for 4 h as needed	Drug of choice for treatment of acute bronchospasm
formoterol (*Foradil*)	Adult and pediatric (≥5 yr) for asthma maintenance: 12-mcg capsule q12h, inhaled using the *Aerolizer inhaler* Adult and pediatric (≥12 yr): 12-mcg capsule inhaled using the *Aerolizer inhaler,* at least 15 min before exercising; do not use additional doses for 12 h	Maintenance treatment of asthma and prevention of bronchospasm in patients ≥5 yr of age with reversible obstructive airway disease; prevention of exercise-induced bronchospasm in patients ≥12 yr of age **Special considerations:** patients taking the drug for asthma maintenance should not use additional doses of the drug for exercise-induced asthma
isoetharine (generic)	Adult: four inhalations from handheld nebulizers or 1–2 mL over 15–20 min with oxygen aerosolization; use caution if patient is >60 yr	Treatment and prophylaxis of bronchospasm (child doses not established)
isoproterenol (*Isuprel*)	Adult: 0.01–0.02 mg IV during anesthesia; 1:200 solution with 5–15 deep inhalations for acute bronchial asthma, or 5–15 inhalations using nebulizer for COPD-related bronchospasm Pediatric: 0.25 mL or the 1:200 solution for each 10–15 min of nebulization	Treatment of bronchospasm during anesthesia; prophylaxis of bronchospasm (when used as inhalant) in adults and children
levalbuterol (*Xopenex*)	Adult and pediatric (>12 yr): 0.63 mg q6–8h by nebulization Pediatric (6–11 yr): 0.31 mg t.i.d. by nebulizer	Treatment and prevention of bronchospasm in patients > 6 yr of age who have reversible obstructive pulmonary disease
metaproterenol (*Alupent*)	Adult: 20 mg PO t.i.d. to q.i.d. Two to three inhalations q3–4h; use caution if patient is >60 yr Pediatric: >12 yr: inhalation and oral doses, same as adult 6–12 yr: nebulizer, 0.1–0.2 mL in saline 6–9 yr: 10 mg PO t.i.d. to q.i.d.	Treatment and prophylaxis of bronchospasm and acute asthma attacks in children ≤6 yr of age
pirbuterol (*Maxair*)	Adult and pediatric (>12 yr): 0.4 mg (two inhalations) q4–6h, do not exceed 12 inhalations per day	Treatment and prophylaxis of bronchospasm in patients ≥12 yr
salmeterol (*Serevent*)	Adult and pediatric (≥12 yr): two puffs q12h; or two puffs 30–60 min before exercise Pediatric (4–12 yr): one inhalation b.i.d. at least 12 h apart; one inhalation ≥30 min before exercising	Prevention of exercise-induced asthma; prophylaxis of bronchospasm in selected patients >4 yr of age
terbutaline (*Brethaire*)	Adult and pediatric (>15 yr): 5 mg PO q6h while awake; 0.25 mg SQ, repeat in 15 min as needed; two inhalations separated by 60 sec q4–6h Pediatric (12–15 yr): 2.5 mg PO t.i.d.; two inhalations separated by 60 sec q4–6h as needed	Treatment and prophylaxis of bronchospasm in patients >12 yr of age
Anticholinergics		
ipratropium (*Atrovent*)	36 mcg (two inhalations) four times per day, up to 12 inhalations if needed; spacer not used Nasal spray: two sprays per nostril t.i.d. to q.i.d.	Maintenance and treatment of bronchospasm for adults with COPD; nasal spray for rhinorrhea associated with seasonal and perennial rhinitis or the common cold
tiotropium (*Spiriva*)	18 mcg/d (one capsule) using the *HandiHaler* inhalation device	Long-term, once-daily maintenance and treatment of bronchospasm associated with COPD in adults



● FIGURE 55.3 Sites of action of drugs used to treat obstructive pulmonary disorders.

Contraindications and Cautions

Caution should be tak en with an y patient with GI problems, coronary disease, respiratory dysfunction, renal or hepatic disease, alcoholism, or hyperthyroidism *because these conditions can be e xacerbated by the systemic effects of xanthines.* Xanthines are a vailable for oral and parenteral use; the parenteral drug should be switched to the oral form as soon as possible *because the systemic effects of the oral form are less acute and more manageable.*

Although no clear studies of xanthines are a vailable in human pregnancy, they have been associated with fetal abnormalities and breathing difficulties at birth in animal studies Use should be limited to situations in which the benefit to th mother clearly outweighs the potential risk to the fetus. Because the xanthines enter breast milk and could af fect the baby, another method of feeding the baby should be selected if these drugs are needed during lactation.

Adverse Effects

Adverse effects associated with xanthines are related to theophylline levels in the blood (*see the Critical Thinking Scenario for additional information on toxic r eaction to theophylline*). Therapeutic theophylline le vels are from 10 to 20 mcg/mL. With increasing le vels, predictable adv erse ef fects are seen, ranging from GI upset, nausea, irritability, and tachycardia to seizures, brain damage, and even death (see Table 55.3).

Clinically Important Drug–Drug Interactions

Because of the mechanism of xanthine metabolism in the liver, many drugs interact with xanthines. The list of interacting

TABLE 55.3 Adverse Effects Associated with Various Serum Levels of Theophylline

SERUM LEVEL (mcg/mL)	ADVERSE EFFECTS
≤20 Uncommon	
>20–25	Nausea, vomiting, diarrhea, insomnia, headache, irritability
>30–35	Hyperglycemia, hypotension, cardiac arrhythmias, tachycardia, seizures, brain damage, death

drugs should be checked any time a drug is added to or removed from a drug regimen.

Nicotine increases the metabolism of xanthines in the liver; xanthine dose must be increased in patients who continue to smoke while using xanthines. In addition, extreme caution must be used if the patient decides to decrease or discontinue smoking, because severe xanthine toxicity can occur.

Prototype Summary: *Aminophylline*

Indications: Symptomatic relief or prevention of bronchial asthma and reversible bronchospasm associated with chronic bronchitis and emphysema.

Actions: Directly relaxes bronchial smooth muscle, causing bronchodilation and increasing vital capacity; also inhibits the release of SRSA and histamine.

Pharmacokinetics:

Route	Onset	Peak	Duration
Oral	1–6 h	4–6 h	6–8 h
IV	Immediate	30 min	4–8 h

$T_{1/2}$: 3 to 15 hours (nonsmoker), 4 to 5 hours (smoker); metabolized in the liver and excreted in urine.

Adverse effects: Irritability, restlessness, dizziness, palpitations, life-threatening arrhythmias, loss of appetite, proteinuria, respiratory arrest, fever, flushing

Nursing Considerations for Patients Receiving Xanthines

Assessment: History and Examination

- Assess for *possible contraindications or cautions*: any known allergies *to prevent hypersensitivity reactions*; cigarette use, *which affects the metabolism of the drug*; peptic ulcer, gastritis, renal or hepatic dysfunction, and coronary disease, *all of which could be exacerbated and require cautious use*; and pregnancy and lactation, *which are contraindications because of the potential for adverse effects on the fetus or nursing baby.*
- Perform a physical examination *to establish baseline data for assessing the effectiveness of the drug and the occurrence of any adverse effects associated with drug therapy.*
- Perform a skin examination, including color and the presence of lesions, *to provide a baseline as a reference for drug effectiveness.*
- Monitor blood pressure, pulse, cardiac auscultation, peripheral perfusion, and baseline electrocardiogram (ECG) *to provide a baseline for effects on the cardiovascular system.*
- Assess bowel sounds and do a liver evaluation, and monitor liver and renal function tests, *to provide a baseline for renal and hepatic function tests.*
- Evaluate serum theophylline levels *to provide a baseline reference and identify conditions that may require caution in the use of xanthines.*

Nursing Diagnoses

Nursing diagnoses related to drug therapy might include the following:

- Acute Pain related to headache and GI upset
- Disturbed Sensory Perception (Kinesthetic, Visual) related to central nervous system (CNS) effects
- Deficient Knowledge regarding drug therapy

Implementation With Rationale

- Administer oral drug with food or milk *to relieve GI irritation if GI upset is a problem.*
- Monitor patient response to the drug (e.g., relief of respiratory difficulty, improved airflow) *to determine the effectiveness of the drug dose and to adjust dose as needed.*
- Provide comfort measures, including rest periods, quiet environment, dietary control of caffeine, and headache therapy as needed, *to help the patient cope with the effects of drug therapy.*
- Provide periodic follow-up, including blood tests, *to monitor serum theophylline levels.*
- Provide thorough patient teaching, including the drug name and prescribed dosage, measures to help avoid adverse effects, warning signs that may indicate problems, and the need for periodic monitoring and evaluation, *to enhance patient knowledge about drug therapy and to promote compliance.*

Evaluation

- Monitor patient response to the drug (improved airflow, ease of respirations).
- Monitor for adverse effects (CNS effects, cardiac arrhythmias, GI upset, local irritation).
- Monitor for potential drug–drug interactions; consult with the prescriber to adjust doses as appropriate.
- Evaluate the effectiveness of the teaching plan (patient can name drug, dosage, adverse effects to watch for, and specific measures to avoid adverse effects).
- Monitor the effectiveness of comfort measures and compliance with the regimen.

CRITICAL THINKING SCENARIO

Toxic Reaction to Theophylline

THE SITUATION

R.P. has a medical diagnosis of chronic bronchitis and has been stabilized on theophylline for the past 3 years. She has been labeled as noncompliant with medical therapy because she continues to smoke cigarettes (more than three packs per day), knowing that she has a progressive pulmonary disease. R.P. was referred to a student nurse for teaching. After several sessions in which the student presented posters and pictures and gave R.P. a great deal of personal attention and encouragement, it was determined that R.P. had a good understanding of her problem and would stop or at least cut down on her smoking. Three days later, R.P. presented to the emergency department with complaints of dizziness, nausea, vomiting, confusion, grouchiness, and palpitations. Her admission heart rate was 96 beats/min with occasional to frequent premature ventricular contractions.

CRITICAL THINKING

What probably happened to R.P.?
What information should the student have known before conducting the teaching program?
How could that information have been included in the patient teaching program?
What would the best approach be to this patient now?

DISCUSSION

R.P. probably did cut down on her smoking. However, she was not aware that cigarette smoking increases the metabolism of theophylline and that she had been stabilized on a dose that took that information into account. When she cut down on smoking, theophylline was not metabolized as quickly and began to accumulate, leading to the toxic reaction that brought R.P. into the emergency department. This is a real nursing challenge. By following the teaching program and doing what she was asked to do, R.P. became sicker and felt awful. A careful teaching approach will be necessary to encourage R.P. to continue cutting down on cigarette smoking.

Staff should be educated on the numerous variables that affect drug therapy and encouraged to check drug interactions frequently when making any changes in a patient's regimen. Regular follow-up and support will be important to help R.P. regain trust in her medical care providers and continue her progress in cutting down smoking. Frequent checks of theophylline levels should be done while R.P. is cutting back, and dose adjustments should be made by her prescriber to maintain therapeutic levels of theophylline and avoid toxic levels.

NURSING CARE GUIDE FOR R.P.: XANTHINES

Assessment: History and Examination

Assessment parameters include a health history focused particularly on allergies, peptic ulcer, gastritis, renal or hepatic dysfunction, coronary disease, cigarette use, pregnancy, and lactation, as well as concurrent use of cimetidine, erythromycin, troleandomycin, ciprofloxacin hormonal contraceptives, ticlopidine, ranitidine, rifampin, barbiturates, phenytoin, benzodiazepines, and beta-blockers.
Focus the physical examination on the following areas:
Neurological: orientation, refl xes, affect, coordination
Respiratory: respiratory rate and character, adventitious sounds
Skin: color, lesions
Cardiovascular: blood pressure, pulse, peripheral perfusion, baseline electrocardiogram
GI: bowel sounds, abdominal exam
Laboratory tests: serum theophylline levels, renal and hepatic function tests

Nursing Diagnoses

Acute Pain related to GI effects or dry mouth
Decreased Cardiac Output
Impaired Sensory Perception (Kinesthetic, Visual)
Activity Intolerance
Deficient Kn wledge regarding drug therapy

Implementation

Provide supportive care with comfort and safety measures:
- Give drug with meals.
- Allow for rest periods.
- Provide a quiet environment.
- Ensure dietary control of caffeine.
- Provide headache therapy as needed.

Provide reassurance to deal with drug effects and lifestyle changes.
Provide patient teaching regarding drug name, dosage, adverse effects, precautions, warnings to report, dietary cautions, and need for follow-up.

Evaluation

Evaluate drug effects: relief of respiratory difficult , improvement of air movement.
Monitor for adverse effects: GI upset, CNS effects, cardiac arrhythmias; monitor for drug–drug interactions as appropriate.
Evaluate the effectiveness of the patient teaching program and comfort and safety measures.

PATIENT TEACHING FOR R.P.

- The drug that has been prescribed for you, theophylline, is called a bronchodilator. Bronchodilators work by relaxing

Toxic Reaction to Theophylline (continued)

the airways, helping to make breathing easier and to decrease wheezes and shortness of breath. To be effective, this drug must be taken exactly as prescribed.
- This drug should be taken on an empty stomach with a full 8-ounce glass of water. If GI upset is severe, you can take the drug with food. Do not chew the enteric-coated or time-release capsules or tablets—they must be swallowed whole to be effective.
- Common effects of this drug include the following:
  - *Gastrointestinal upset, nausea, vomiting, heartburn*: Taking the drug with food may help with these problems.
  - *Restlessness, nervousness, difficulty in sleepin* : The body often adjusts to these effects over time. Avoiding other stimulants, such as caffeine, may help to decrease some of these symptoms.
  - *Headache*: This often goes away with time. If headaches persist or become worse, notify your health care provider.
  - Report any of the following to your health care provider: *vomiting, severe abdominal pain, pounding or fast heartbeat, confusion, unusual tiredness, muscle twitching, skin rash, or hives.*
- Many foods can change the way that your drug works; if you decide to change your diet, consult with your health care provider.
- Adverse effects of the drug can be avoided by avoiding foods that contain caffeine or other xanthine derivatives (coffee, cola, chocolate, tea) or by using them in moderate amounts. This is especially important if you experience nervousness, restlessness, or sleeplessness.
- Cigarette smoking affects the way your body uses this drug. If you decide to change your smoking habits, such as increasing or decreasing the number of cigarettes you smoke each day, consult with your health care provider regarding the possible need to adjust your dose.
- Avoid the use of any over-the-counter medication without first checking with your health care pr vider. Several of these medications can interfere with the effectiveness of this drug.
- Tell any doctor, nurse, or other health care provider involved in your care that you are taking this drug.
- Keep this drug and all medications out of the reach of children.

Sympathomimetics

Sympathomimetics are drugs that mimic the ef fects of the sympathetic nervous system. One of the actions of the sympathetic nerv ous system is dilation of the bronchi with increased rate and depth of respiration. This is the desired effect when selecting a sympathomimetic as a bronchodilator. Sympathomimetics that are used as bronchodilators include albuterol (*Proventil* and others), arformoterol (*Brovana*), bitolterol (*Tornalate*), ephedrine (generic), epinephrine (*EpiPen*), formoterol (*Foradil*), isoetharine (generic), isoproterenol (*Isuprel* and others), levalbuterol (*Xopenex*), metaproterenol (*Alupent*), pirbuterol (*Maxair*), salmeterol (*Serevent*), and terbutaline (*Brethaire* and others).

Therapeutic Actions and Indications

Most of the sympathomimetics used as bronchodilators are beta$_2$-selective adrener gic agonists. That means that at therapeutic le vels their actions are specific to the bet $_2$-receptors found in the bronchi (see Chapter 30). This specificity is lost a higher le vels. Other systemic ef fects of sympathomimetics include increased blood pressure, increased heart rate, vasoconstriction, and decreased renal and GI blood fl w—all actions of the sympathetic nervous system. These overall effects limit the systemic usefulness of these drugs in certain patients.

Epinephrine, the prototype drug, is the drug of choice in adults and children for the treatment of acute bronchospasm, including that caused by anaphylaxis; it is also a vailable for inhalation. Because epinephrine is associated with systemic sympathomimetic ef fects, it is not the drug of choice for patients with cardiac conditions. See Table 55.2 for usual indications for each of these agents.

Pharmacokinetics

Sympathomimetics available only as an inhalant include the arformoterol, formoterol, isoetharine, levalbuterol, pirbuterol, and salmeterol.

Other sympathomimetics are a vailable in v arious forms. Albuterol and metaproterenol are available in inhaled and oral forms. Terbutaline can be used as an inhalant and as an oral and parenteral agent. Isoproterenol is available for intravenous use. Ephedrine is used orally and in parenteral form (for IV , IM, and SQ use).

These drugs are rapidly distrib uted after injection; the y are transformed in the liver to metabolites that are excreted in the urine. The half-life of these drugs is relatively short—less than 1 hour. They are known to cross the placenta and to enter breast milk (see Contraindications and Cautions). The inhaled drugs are rapidly absorbed into the lung tissue. Although very little of the drug is absorbed systemically, any

absorbed drug will still be metabolized in the li ver and excreted in urine.

Contraindications and Cautions

These drugs are contraindicated or should be used with caution, depending on the se verity of the underlying condition, *in conditions that would be a ggravated by the sympathetic stimulation,* including cardiac disease, vascular disease, arrhythmias, diabetes, and hyperthyroidism. These drugs should be used during pregnancy and lactation only if the benefits to the mother clearly outweigh potential risks to th fetus or neonate.

Adverse Effects

Adverse ef fects of these drugs, which can be attrib uted to sympathomimetic stimulation, include CNS stimulation, GI upset, cardiac arrhythmias, hypertension, bronchospasm, sweating, pallor, and flushing. Isoproterenol is associate with more cardiac side effects than some other drugs.

If the patient is taking formoterol for asthma maintenance, additional doses of drug should not be used for e xercise-induced asthma because the cumulative sympathomimetic effects can cause serious cardiovascular problems. Salmeterol has greater risk of asthma-related deaths in African American patients (see Box 55.3).

Clinically Important Drug–Drug Interactions

Special precautions should be taken to avoid the combination of sympathomimetic bronchodilators with the general anesthetics cyclopropane and halogenated hydrocarbons. Because these drugs sensitize the myocardium to catecholamines, serious cardiac complications could occur.

FOCUS ON BOX 55.3 Cultural Considerations

As a result of postmarketing studies, the boxed warning label on the asthma drug salmeterol (*Serevent*) was changed to warn of a small but significant increase in th risk of life-threatening asthma episodes in patients using salmeterol. In the study, which involved 13,000 patients each in a salmeterol treatment group and a control group, there were 13 asthma-related deaths in a 28-week period in the salmeterol group compared with 4 asthma-related deaths in the control group. The study showed that African American patients had a greater risk of asthma-related deaths than did other groups. The FDA agreed that the benefit of using salmeterol for the treatment of asthma wa greater than the risk that the drug poses, but cautioned health care professionals to be cautious when prescribing these drugs.

FOCUS ON Safe Medication Administration

Name confusion has been reported between *Maxair* (pirbuterol)—a sympathomimetic agent used for the treatment of asthma—and *Maxalt* (rizatriptan)—a triptan used for the treatment of migraine headaches. Serious adverse effects have occurred when these drugs were inadvertently confused. Use caution if you have a patient on either of these drugs.

Prototype Summary: *Epinephrine*

Indications: Treatment of anaphylactic reactions, acute asthmatic attacks; relief from respiratory distress of COPD and bronchial asthma.

Actions: Reacts at alpha- and beta-receptor sites in the sympathetic nervous system to cause bronchodilation, increased heart rate, increased respiratory rate, and increased blood pressure.

Pharmacokinetics:

Route	Onset	Peak	Duration
SC	5–10 min	20 min	20–30 min
IM	5–10 min	20 min	20–30 min
IV	Instant	20 min	20–30 min
Inhalation	3–5 min	20 min	1–3 h

$T_{1/2}$: Unknown; metabolized by normal neural pathways.

Adverse effects: Fear, anxiety, restlessness, headache, nausea, decreased renal formation, pallor, palpitation, tachycardia, local b urning and stinging, rebound congestion with nasal inhalation.

Nursing Considerations for Patients Receiving Sympathomimetics

Assessment: History and Examination

- Assess for *possible contraindications or cautions*: any known allergies to any sympathomimetic or drug vehicle *to prevent hypersensitivity reactions*; cigarette use, *which affects the metabolism of the drug;* pregnancy or lactation, *which require cautious use of the drug*; cardiac disease, vascular disease, arrhythmias, diabetes, and hyperthyroidism, *which may be exacerbated by sympathomimetic effects*; and use of the general anesthetics cyclopropane and halogenated hydrocarbons, *which sensitize the myocardium to catecholamines and could cause serious cardiac complications if used with these drugs.*
- Perform a physical examination *to establish baseline data for assessing the effectiveness of the drug and the occurrence of any adverse effects associated with drug therapy.*
- Assess reflexes and orientation *to evaluate CNS effects of the drug.*
- Monitor respirations and adventitious sounds *to establish a baseline for drug effectiveness and possible adverse effects.*

- Evaluate pulse, blood pressure, and, in certain cases, a baseline ECG *to monitor the cardiovascular effects of sympathetic stimulation.*
- Evaluate liver function tests *to assess for changes that could interfere with metabolism of the drug and require dose adjustment.*

Nursing Diagnoses

Nursing diagnoses related to drug therapy might include the following:

- Increased Cardiac Output related to sympathomimetic effects
- Acute Pain related to CNS, GI, or cardiac effects of the drug
- Disturbed Thought Processes related to CNS effects
- Deficient Knowledge related to drug therapy

Implementation With Rationale

- Reassure patient that the drug of choice will vary with each individual. *These sympathomimetics are slightly different chemicals and are prepared in a variety of delivery systems.* A patient may have to try several different sympathomimetics before the most effective one is found.
- Advise the patient to use the minimal amount needed for the shortest period necessary *to prevent adverse effects and accumulation of drug levels.*
- Teach patients who use one of these drugs for exercise-induced asthma to use it 30 to 60 minutes before exercising *to ensure peak therapeutic effects when they are needed.*
- Provide safety measures as needed if CNS effects become a problem *to prevent patient injury.*
- Provide small, frequent meals and nutritional consultation if GI effects interfere with eating *to ensure proper nutrition.*
- Provide thorough patient teaching, including the drug name and prescribed dosage, measures to help avoid adverse effects, warning signs that may indicate problems, and the need for periodic monitoring and evaluation, *to enhance patient knowledge about drug therapy and to promote compliance.* Carefully teach the patient about proper use of the prescribed delivery system. Review that procedure periodically *because improper use may result in ineffective therapy* (Box 55.4).
- Offer support and encouragement *to help the patient cope with the disease and the drug regimen.*

Evaluation

- Monitor patient response to the drug (improved breathing).
- Monitor for adverse effects (CNS effects, increased pulse and blood pressure, GI upset).
- Evaluate the effectiveness of the teaching plan (patient can name drug, dosage, adverse effects to watch for, specific measures to avoid them, and measures to take to increase the effectiveness of the drug).
- Monitor the effectiveness of other measures to ease breathing.

Anticholinergics

Patients who cannot tolerate the sympathetic effects of the sympathomimetics might respond to the anticholinergic drugs ipratropium (*Atrovent*) and tiotropium (*Spiriva*). These drugs are not as effective as the sympathomimetics but can provide some relief to those patients who cannot tolerate the other drugs. Tiotropium is the first drug approved for once-daily maintenance treatment of bronchospasm associated with COPD.

Therapeutic Actions and Indications

Anticholinergics are used as bronchodilators because of their effect on the vagus nerve, which is to block or antagonize the action of the neurotransmitter acetylcholine at vagal-mediated receptor sites (see Figure 55.2). Normally, vagal stimulation results in a stimulating effect on smooth muscle, causing contraction. By blocking the vagal effect, relaxation of smooth muscle in the bronchi occurs, leading to bronchodilation. See Table 55.2 for usual indications for these drugs.

Pharmacokinetics

These drugs are available for inhalation, using an inhaler device. Ipratropium is also available as a nasal spray for seasonal rhinitis. Ipratropium has an onset of action of 15 minutes when inhaled. Its peak effects occur in 1 to 2 hours, and it has a duration of effect of 3 to 4 hours. Little is known about its fate in the body. It is generally not absorbed systemically.

Tiotropium has a rapid onset of action and a long duration, with a half-life of 5 to 6 days. It is excreted unchanged in urine.

Contraindications and Cautions

Caution should be used in any condition *that would be aggravated by the anticholinergic or atropine-like effects of the drug*, such as narrow-angle glaucoma (*drainage of the vitreous humor can be blocked by smooth muscle relaxation*), bladder neck obstruction, or prostatic hypertrophy (*relaxed muscle causes decreased bladder tone*), and conditions aggravated by dry mouth and throat. The use of ipratropium or tiotropium is contraindicated in the presence of known allergy to the drug or to soy products or peanuts (the vehicle used to make ipratropium an aerosol contains a protein associated with peanut allergies) *to prevent hypersensitivity reactions*. These drugs are not usually absorbed systemically, but, as with all drugs, caution should be used in pregnancy and lactation *because of the potential for adverse effects on the fetus or nursing baby.*

FOCUS ON Safe Medication Administration

The propellant used to make ipratropium an inhaled drug has a cross-sensitivity to the antigen that causes peanut allergies. Patients who are started on inhaled ipratropium, or the combination drug *Combivent* should be questioned about the possibility of peanut allergies, which would make this drug contraindicated. With the number of reported peanut allergies growing each year, it is an important safety reminder to check with patients about food allergies, as well as known drug allergies.

BOX 55.4 FOCUS ON *Patient and Family Teaching*

Teaching Patients to Self-Administer Medication

It is important to deliver inhaled drugs into the lungs to achieve a rapid reaction and decrease the occurrence of systemic adverse effects. Patients who are self-administering inhaled drugs may be using an inhaler or a nebulizer.

Inhalers

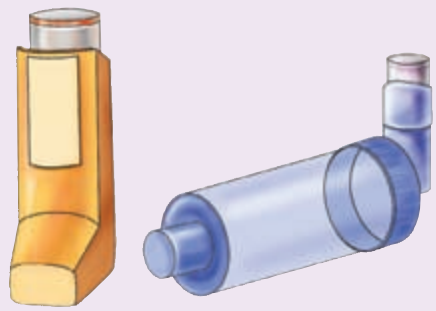
An inhaler is a device that allows a canister containing the drug to be inserted into a metered-dose device that will deliver a specific amount of the drug when the patient com presses the canister. The inhaler has a mouthpiece and may also have a spacer, which is used to hold the dose of the drug while the patient inhales. This is advantageous if the patient has difficulty compressing the canister and inhalin at the same time or if inhaling is difficult. If a powder fo inhalation is being administered, a spacer is not used.

Have the patient shake the canister, exhale, and then place the spacer in his or her mouth. (If a spacer is not being used, he or she should hold the device about 1 inch from the open mouth.) The patient should then compress the canister while inhaling, hold his or her breath as long as possible, and then exhale through pursed lips. The patient should then rinse his or her mouth and wash the spacer (if used). Some drugs come with a very specific inhaling device designed just fo that drug. If the patient is using one of those drugs, the man-ufacturer's instructions should be consulted.

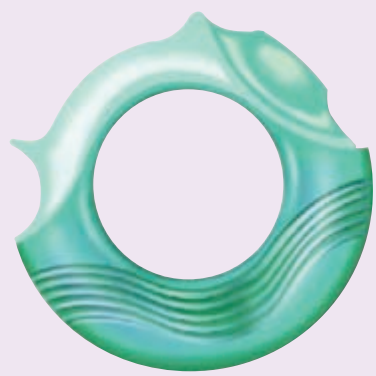
Nebulizers

A nebulizer uses compressed air to change a liquid drug into a fine mist for inhalation. If a patient is using a handhel device or a mask, he or she should sit upright or in a semi-Fowler's position and place the correct amount of liquid (drug dose) in the nebulizer chamber, which is attached to a compressed gas system. The patient should breathe slowly and deeply during the treatment. After the liquid is gone, the patient should rinse his or her mouth and clean the mask or device.

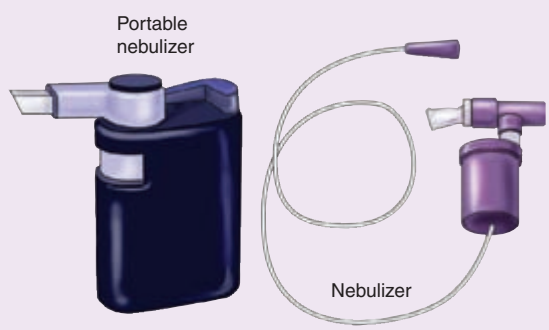
Patients may use these devices for several years. It is important to check their administration techniques periodi-cally to ensure that the patient is getting a therapeutic dose of the drug.



MDI MDI with spacer



Dry-powder inhaler



Adverse Effects

Adverse effects are related to the anticholinergic effects of the drug if it is absorbed systemically. These effects include dizziness, headache, fatigue, nervousness, dry mouth, sore throat, palpitations, and urinary retention.

Clinically Important Drug–Drug Interactions

There is an increased risk of adverse effects if these drugs are combined with any other anticholinergics; this combination should be avoided.

Prototype Summary: *Ipratropium*

Indications: Maintenance treatment of bronchospasm associated with COPD; treatment of seasonal allergic rhinitis as a nasal spray.

Actions: Anticholinergic that blocks vagally mediated reflexes by antagonizing the action of acetylcholine.

Pharmacokinetics:

Route	Onset	Peak	Duration
Inhalation	15 min	1–2 h	3–4 h

$T_{1/2}$: Unknown; metabolized by neural pathways.

Adverse effects: Nervousness, dizziness, headache, nausea, GI distress, cough, palpitations.

Nursing Considerations for Patients Receiving an Anticholinergics

Assessment: History and Examination

- Assess for *possible contraindications or cautions*: allergy to atropine or other anticholinergics or any component of the drug *to prevent hypersensitivity reactions*; acute bronchospasm, *which would be a contraindication*; narrow-angle glaucoma (*drainage of the vitreous humor can be blocked by smooth muscle relaxation*), bladder neck obstruction or prostatic hypertrophy (*relaxed muscle causes decreased bladder tone*), and conditions aggravated by dry mouth and throat, *all of which could be exacerbated by the use of this drug*; and pregnancy and lactation, *which would require cautious use.*
- Perform a physical examination *to establish baseline data for assessing the effectiveness of the drug and the occurrence of any adverse effects associated with drug therapy.*
- Assess the skin color and lesions *to assess for dryness or allergic reaction and to evaluate oxygenation.*
- Evaluate orientation, affect, and reflexes *to evaluate CNS effects.*
- Assess pulse and blood pressure *to monitor cardiovascular effects of the drug.*
- Evaluate respirations and adventitious sounds *to monitor drug effectiveness and possible adverse effects.*
- Evaluate urinary output and prostate palpation as appropriate *to monitor anticholinergic effects.*

Nursing Diagnoses

Nursing diagnoses related to drug therapy might include the following:

- Acute Pain related to CNS, GI, or respiratory effects of the drug
- Imbalanced Nutrition: Less Than Body Requirements related to dry mouth and GI upset
- Deficient Knowledge regarding drug therapy

Implementation With Rationale

- Ensure adequate hydration and provide environmental controls, such as the use of a humidifier, *to make the patient more comfortable.*
- Encourage the patient to void before each dose of medication *to prevent urinary retention related to drug effects.*
- Provide safety measures if CNS effects occur *to prevent patient injury.*
- Provide small, frequent meals and sugarless lozenges *to relieve dry mouth and GI upset.*
- Advise the patient not to drive or use hazardous machinery if nervousness, dizziness, and drowsiness occur with this drug *to prevent injury.*
- Provide thorough patient teaching, including the drug name and prescribed dosage, measures to help avoid adverse effects, warning signs that may indicate problems, and the need for periodic monitoring and evaluation, *to enhance patient knowledge about drug therapy and to promote compliance.*
- Review the use of the inhalator with the patient; caution the patient not to exceed 12 inhalations in 24 hours *to prevent serious adverse effects.*
- Offer support and encouragement *to help the patient cope with the disease and the drug regimen.*

Evaluation

- Monitor patient response to the drug (improved breathing).
- Monitor for adverse effects (CNS effects, increased pulse or blood pressure, GI upset, dry skin and mucous membranes).
- Evaluate the effectiveness of the teaching plan (patient can name drug, dosage, adverse effects to watch for, specific measures to avoid them, and measures to take to increase the effectiveness of the drug).
- Monitor the effectiveness of other measures to ease breathing.

KEY POINTS

- Asthma, emphysema, chronic obstructive pulmonary disease (COPD), and respiratory distress syndrome (RDS) are pulmonary obstructive diseases. All but RDS involve obstruction of the major airways; RDS obstructs the alveoli.
- Drug treatment of asthma and COPD aims to relieve inflammation and promote bronchial dilation.
- Xanthine-derived drugs affect the smooth muscles of the respiratory tract—both in the bronchi and in the blood vessels. The effects of the xanthines are directly related to blood levels of theophylline. Excessive or toxic levels can lead to coma and death.
- Sympathomimetics replicate the effects of the sympathetic nervous system; they dilate the bronchi and increase the rate and depth of respiration.
- Anticholinergics affect the vagus nerve to relax bronchial smooth muscle and thereby promote bronchodilation.

DRUGS AFFECTING INFLAMMATION

Bronchodilation is important in opening up the airway to allow air to flow into the alveoli. The second component of treating obstructive pulmonary disorders is to alter the inflammatory process that leads to swelling and further airway narrowing. Effective treatment of asthma and COPD targets both components. The drugs used to affect inflammation are the inhaled steroids, the leukotriene receptors, and a mast cell stabilizer, which can affect both bronchodilation and inflammation (Table 55.4).

Inhaled Steroids

Inhaled steroids have been found to be a very effective treatment for bronchospasm. Agents approved for this use include beclomethasone (*Beclovent* and others), budesonide (*Pulmicort*), ciclesonide (*Alvesco*), fluticasone (*Flovent*), and triamcinolone (*Azmacort* and others). The drug of choice depends on the individual patient's response; a patient may have little response to one agent and do very well on another. It is usually useful to try another preparation if one is not effective within 2 to 3 weeks.

Fixed-combination drugs are also available using some of these drugs (Box 55.5).

Therapeutic Actions and Indications

Inhaled steroids are used to decrease the inflammatory response in the airway. In an airway that is swollen and narrowed by inflammation and swelling this action will increase airflow and facilitate respiration. Inhaling the steroid tends to decrease the numerous systemic effects that are associated with steroid use. When administered into the lungs by inhalation, steroids decrease the effectiveness of the inflammatory cells. This has two effects: decreased swelling associated with inflammation and promotion of beta-adrenergic receptor activity, which may promote smooth muscle relaxation and inhibit bronchoconstriction (see Figure 55.2). See Table 55.4 for usual indications.

Pharmacokinetics

These drugs are rapidly absorbed from the respiratory tract, but they take from 2 to 3 weeks to reach effective levels, and so patients must be encouraged to take them to reach and then maintain the effective levels. They are metabolized by natural systems, mostly within the liver, and are excreted in urine. The glucocorticoids are known to cross the placenta and to enter breast milk (see Contraindications and Cautions).

Contraindications and Cautions

Inhaled steroids are not for emergency use and not for use during an acute asthma attack or status asthmaticus. They should not be used during pregnancy or lactation unless the benefit to the mother clearly outweighs any potential risk to the fetus or nursing baby. These preparations should be used with caution in any patient who has an active infection of the respiratory system *because the depression of the inflammatory response could result in serious illness.*

Adverse Effects

Adverse effects are limited because of the route of administration. Sore throat, hoarseness, coughing, dry mouth, and pharyngeal and laryngeal fungal infections are the most common side effects encountered. If a patient does not administer the drug appropriately or develops lesions that allow absorption of the drug, the systemic side effects associated with steroids may occur.

Prototype Summary: *Budesonide*

Indications: Prevention and treatment of asthma; to treat chronic steroid-dependent bronchial asthma; as adjunct therapy for patients whose asthma is not controlled by traditional bronchodilators.

Actions: Decreases the inflammatory response in the airway; this action will increase airflow and facilitate respiration in an airway narrowed by inflammation

Pharmacokinetics:

Route	Onset	Peak	Duration
Inhalation	Slow	Rapid	8–12 h

$T_{1/2}$: 2 to 3 hours; metabolized in the liver and excreted in urine.

Adverse effects: Irritability, headache, rebound congestion, epistaxis, local infection.

TABLE 55.4 DRUGS IN FOCUS Drugs Affecting Inflammation

Drug Name	Usual Dosage	Usual Indications
Inhaled Steroids		
beclomethasone (*Beclovent*)	Adult: 84–168 mcg t.i.d. to q.i.d. (two inhalations) Pediatric (6–12 yr): one to two inhalations t.i.d. to q.i.d., do not exceed 10 inhalations per day	Prevention and treatment of asthma; treatment of chronic steroid-dependent bronchial asthma; used as adjunctive therapy for asthma patients who do not respond to traditional bronchodilators
budesonide (*Pulmicort*)	Adult and pediatric (>6 y): 200–400 mcg b.i.d. (two inhalations), maximum dose 800 mcg b.i.d. Pediatric (>6 yr): 200 mcg b.i.d.	Prevention and treatment of asthma; treatment of chronic steroid-dependent bronchial asthma; used as adjunctive therapy for asthma patients who do not respond to traditional bronchodilators
ciclesonide *(Alvesco)*	Adult and pediatric ≥12 yr: 80–320 mcg b.i.d. by inhalation	Prevention and treatment of asthma; treatment of chronic steroid-dependent bronchial asthma; used as adjunctive therapy for asthma patients who do not respond to traditional bronchodilators
fluticasone (*Flovent*)	Adult: 88–440 mcg b.i.d. by inhalation Pediatric (4–11 yr): 50–100 mcg b.i.d. by inhalation	Prevention and treatment of asthma; treatment of chronic steroid-dependent bronchial asthma; used as adjunctive therapy for asthma patients who do not respond to traditional bronchodilators
triamcinolone (*Azmacort*)	Adult: two inhalations (200 mcg) t.i.d. to q.i.d. Pediatric (6–12 yr): one to two inhalations t.i.d. to q.i.d.	Prevention and treatment of asthma; treatment of chronic steroid-dependent bronchial asthma; used as adjunctive therapy for asthma patients who do not respond to traditional bronchodilators
Leukotriene Receptor Antagonists		
montelukast (*Singulair*)	Adult and pediatric (>15 yr): 10 mg PO daily in the evening Pediatric (6–23 mo): 4-mg granules PO in the evening 2–5 yr: 4-mg chewable tablet PO in the evening 6–14 yr: 5-mg chewable tablet PO in the evening	Prophylaxis and treatment of chronic bronchial asthma in adults and children 6 mo and older
zafirlukast (*Accolate*)	Adult and pediatric (>12 yr): 20 mg PO b.i.d. Pediatric (5–11 yr): 10 mg PO b.i.d.	Prophylaxis and treatment of chronic bronchial asthma in adults and in chlidren 5 yr and older
zileuton (*Zyfl*)	Adult and pediatric (≥12 yr): 600 mg PO q.i.d. for a total of 2,400 mg/d	Prophylaxis and treatment of chronic bronchial asthma in patients ≥12 yr of age
Mast Cell Stabilizer		
cromolyn (*Nasalcrom*)	Adult and pediatric (>5 yr): 20 mg inhaled q.i.d. Adult and pediatric (>2 yr): 20 mg q.i.d. via nebulizer Adult and pediatric (>6 yr): one spray of nasal solution in each nostril three to six times per day Adult: two ampules PO q.i.d. Pediatric (2–12 yr): one ampule PO q.i.d.	Treatment of chronic bronchial asthma, exercise-induced asthma, and allergic rhinitis

Nursing Considerations for Patients Receiving Inhaled Steroids

Assessment: History and Examination

- Assess for *possible contraindications or cautions*: acute asthmatic attacks and allergy to the drugs, *which are contraindications*, and systemic infections, pregnancy, or lactation, *which require cautious use.*
- Perform a physical examination *to establish baseline data for assessing the effectiveness of the drug and the occurrence of any adverse effects associated with drug therapy.*
- Assess temperature *to monitor for possible infections.*

BOX 55.5 Fixed-Combination Respiratory Drugs

The benefit of combining different classes of drugs for the treatment of asthma has resulted in the development of fixed-combination drugs.

- *Advair Diskus* and *Advair HFA* are combinations of fluticasone (a steroid) and salmeterol (a sympathetic agent). They are approved for managing asthma in patients 4 years of age and older.
- *Combivent* is a combination of ipratropium (an anticholinergic agent) and albuterol (a sympathetic agent).
- *Symbicort* is a combination of budesonide (a corticosteroid) and formoterol (a sympathetic agent).

Patients should be stabilized on each drug separately before switching to the fixed-combination drug. Once the switch has been made, the dosing is cut in half, and most patients find it easier to be compliant with drug therapy.

- Monitor blood pressure, pulse, and auscultation *to evaluate cardiovascular response.*
- Assess respirations and adventitious sounds *to monitor drug effectiveness.*
- Examine the nares *to evaluate for any lesions that might lead to systemic absorption of the drug.*

Nursing Diagnoses

Nursing diagnoses related to drug therapy might include the following:

- Risk for Injury related to immunosuppression
- Acute Pain related to local effects of the drug
- Deficient Knowledge regarding drug therapy

Implementation With Rationale

- Do not administer the drug to treat an acute asthma attack or status asthmaticus *because these drugs are not intended for treatment of acute attack and will not provide the immediate relief that is needed.*
- Taper systemic steroids carefully during the transfer to inhaled steroids; *deaths have occurred from adrenal insufficiency with sudden withdrawal.*
- Have the patient use decongestant drops before using the inhaled steroid *to facilitate penetration of the drug if nasal congestion is a problem.*
- Have the patient rinse the mouth after using the inhaler *because this will help to decrease systemic absorption and decrease GI upset and nausea.*
- Monitor the patient for any sign of respiratory infection; *continued use of steroids during an acute infection can lead to serious complications related to the depression of the inflammatory and immune responses.*
- Provide thorough patient teaching, including the drug name and prescribed dosage, measures to help avoid adverse effects, warning signs that may indicate problems, and the need for periodic monitoring and evaluation, *to enhance patient knowledge about drug therapy and to promote compliance.*
- Instruct the patient to continue to take the drug *to reach and then maintain effective levels (drug takes 2 to 3 weeks to reach effective levels).*
- Offer support and encouragement *to help the patient cope with the disease and the drug regimen.*

Evaluation

- Monitor patient response to the drug (improved breathing).
- Monitor for adverse effects (nasal irritation, fever, GI upset).
- Evaluate the effectiveness of the teaching plan (patient can name drug, dosage, adverse effects to watch for, specific measures to avoid them, and measures to take to increase the effectiveness of the drug).
- Monitor the effectiveness of other measures to ease breathing.

Leukotriene Receptor Antagonists

A newer class of drugs, the **leukotriene receptor antagonists,** was developed to act more specifically at the site of the problem associated with asthma. Zafirlukast (*Accolate*) was the first drug of this class to be developed. Montelukast (*Singulair*) and zileuton (*Zyflo*) are the other drugs currently available in this class. Because this class is relatively new, long-term effects and the benefits of one drug over another have not yet been determined.

Therapeutic Actions and Indications

Leukotriene receptor antagonists selectively and competitively block (zafirlukast, montelukast) or antagonize (zileuton) receptors for the production of leukotrienes D_4 and E_4, components of SRSA. As a result, these drugs block many of the signs and symptoms of asthma, such as neutrophil and eosinophil migration, neutrophil and monocyte aggregation, leukocyte adhesion, increased capillary permeability, and smooth muscle contraction. These factors contribute to the inflammation, edema, mucus secretion, and bronchoconstriction seen in patients with asthma. See Table 55.4 for usual indications of these drugs. They do not have immediate effects on the airways and are not indicated for treating acute asthma attacks.

Pharmacokinetics

These drugs are given orally. They are rapidly absorbed from the GI tract. Zafirlukast and montelukast are extensively metabolized in the liver by the cytochrome P450 system and are primarily excreted in feces. Zileuton is metabolized and cleared through the liver. These drugs cross the placenta and enter breast milk (see Contraindications and Cautions).

Contraindications and Cautions

These drugs should be used cautiously in patients with hepatic or renal impairment *because these conditions can affect the drug's metabolism and excretion.* Fetal toxicity has been reported in animal studies, so these drugs should be used

during pregnancy only if the benefit to the mother clearly out weighs the potential risks to the fetus. No adequate studies have been done on the ef fects on the baby if these drugs are used during lactation; caution should be used.

These drugs are not indicated for the treatment of acute asthmatic attacks; they do not provide any immediate effects on the airways. Patients need to be cautioned that they should not rely on these drugs for relief from an acute asthmatic attack.

Adverse Effects

Adverse effects associated with leuk otriene receptor antagonists include headache, dizziness, myalgia, nausea, diarrhea, abdominal pain, elevated liver enzyme concentrations, vomiting, generalized pain, fever, and myalgia. Because these drugs are relatively new, there is little information about their long-term effects. Patients should be advised to monitor their use of these drugs and to report an y increase of acute episodes or lack of response to the drug,which could indicate a worsening problem or decreased responsiveness to drug therapy.

Clinically Important Drug–Drug Interactions

Use caution if propranolol, theophylline, terfenadine, or warfarin is taken with these drugs because increased toxicity can occur. Toxicity may also occur if these drugs are combined with calcium channel block ers, cyclosporine, or aspirin; decreased dose of either drug may be necessary.

Prototype Summary: *Zafirlukas*

Indications: Prevention and long-term treatment of asthma in adults and children 5 years of age or older.

Actions: Specifically blocks receptors for leu otrienes, which are components of SRSA, blocking airw ay edema and processes of inflammation in the air ay.

Pharmacokinetics:

Route	Onset	Peak	Duration
Oral	Rapid	3 h	Unknown

$T_{1/2}$: 10 hours; metabolized in the li ver and excreted in urine and feces.

Adverse effects: Headache, dizziness, nausea, generalized pain and fever, infection.

Nursing Considerations for Patients Receiving Leukotriene Receptor Antagonists

Assessment: History and Examination

- Assess for *possible contraindications or cautions*: allergy to the drug and acute bronchospasm or asthmatic attack, *all of which would be contraindications to the use of the drug*; impaired renal or hepatic function, *which could alter the metabolism and excretion of the drug and might require a dose adjustment*; and pregnancy or lactation, *which require cautious use.*
- Perform a physical examination *to establish baseline data for assessing the effectiveness of the drug and the occurrence of any adverse effects associated with drug therapy.*
- Evaluate temperature *to monitor for underlying infection.*
- Assess orientation and affect *to monitor for CNS effects of the drug.*
- Evaluate respirations and adventitious breath sounds *to monitor the effectiveness of the drug.*
- Evaluate liver and renal function tests *to assess for impairments that could interfere with metabolism or excretion of the drugs.*
- Perform an abdominal evaluation *to monitor GI effects of the drug.*

Nursing Diagnoses

Nursing diagnoses related to drug therapy might include the following:

- Acute Pain related to headache, GI upset, or myalgia
- Risk for Injury related to CNS effects
- Deficient Knowledge regarding drug therapy

Implementation With Rationale

- Administer drug on an empty stomach, 1 hour before or 2 hours after meals; *the bioavailability of these drugs is decreased markedly by the presence of food.*
- Caution the patient that these drugs are not to be used during an acute asthmatic attack or bronchospasm; *instead, regular emergency measures will be needed.*
- Caution the patient to take the drug continuously and not to stop the medication during symptom-free periods *to ensure that therapeutic levels are maintained.*
- Provide appropriate safety measures if dizziness occurs *to prevent patient injury.*
- Urge the patient to avoid over-the-counter preparations containing aspirin, *which might interfere with the effectiveness of these drugs.*
- Provide thorough patient teaching, including the drug name and prescribed dosage, measures to help avoid adverse effects, warning signs that may indicate problems, and the need for periodic monitoring and evaluation, *to enhance patient knowledge about drug therapy and to promote compliance.*
- Offer support and encouragement *to help the patient cope with the disease and the drug regimen.*

Evaluation

- Monitor patient response to the drug (improved breathing).
- Monitor for adverse effects (drowsiness, headache, abdominal pain, myalgia).
- Evaluate the effectiveness of the teaching plan (patient can name drug, dosage, adverse effects to watch for, specific measures to avoid them, and measures to take to increase the effectiveness of the drug).
- Monitor the effectiveness of other measures to ease breathing.

Mast Cell Stabilizer

A **mast cell stabilizer** prevents the release of inflammatory and bronchoconstricting substances when the mast cells are stimulated to release these substances because of irritation or the presence of an antigen. Cromlyn (*Nasalcrom*) is the only drug still available in this class.

Therapeutic Actions and Indications

Cromolyn is used for the treatment of asthma and allergies (see Table 55.4 for usual indications). It works at the cellular level to inhibit the release of histamine (released from mast cells in response to inflammation or irritation) and inhibits the release of SRSA (see Figure 55.2). By blocking these chemical mediators of the immune reaction, cromolyn prevents the allergic asthmatic response when the respiratory tract is exposed to the offending allergen. Because there are now so many other drugs that affect inflammation that are more effective with fewer adverse effects, cromolyn is not used as often as in the past. It is used as an ophthalmic solution for the treatment of eye-related allergic symptoms, as a nasal spray for seasonal allergic rhinitis, and in an inhaled form for the treatment of allergies.

Pharmacokinetics

Cromolyn is inhaled from a capsule and may not reach its peak effect for 1 week. It is also available as a nasal spray and as an ophthalmic solution that have little systemic absorption. It is primarily active in the lungs, and most of the inhaled dose is excreted during exhalation or, if swallowed, excreted in urine and feces.

Contraindications and Cautions

Cromolyn is contraindicated in the presence of known allergy to the drug *to prevent hypersensitivity reactions.* Cromolyn cannot be used during an acute attack, and patients need to be instructed in this precaution. *Because safety for use in pregnancy and lactation has not been established*, use should be reserved for those situations when the benefit to the mother greatly outweighs any potential risk to the fetus or neonate. Cromolyn is not recommended for children younger than 2 years of age.

Adverse Effects

Few adverse effects have been reported with the use of cromolyn; those that do occur on occasion include swollen eyes, headache, dry mucosa, and nausea. Careful patient management (avoidance of dry or smoky environments, analgesics, use of proper inhalation technique, use of a humidifier, and pushing fluids as appropriate) can help to make drug-related discomfort tolerable.

Prototype Summary: *Cromolyn*

Indications: Prophylaxis of severe bronchial asthma; prevention of exercise-induced asthma.

Actions: Inhibits the allergen-triggered release of histamine, SRSA, and leukotrienes from mast cells; decreases the overall allergic response in the airways.

Pharmacokinetics:

Route	Onset	Peak	Duration
Inhaled	Slow	15 min	6–8 h

$T_{1/2}$: 80 minutes; metabolized in the liver and excreted via exhalation.

Adverse effects: Headache, dizziness, nausea, sore throat, dysuria, cough, nasal congestion.

Nursing Considerations for Patients Receiving a Mast Cell Stabilizer

Assessment: History and Examination

- Assess for *possible contraindications or cautions*: allergy to cromolyn *to prevent hypersensitivity reactions*; impaired renal or hepatic function, *which could interfere with the metabolism or excretion of the drug, leading to a need for dose adjustment;* and pregnancy or lactation, *which require very cautious administration.*
- Perform a physical examination *to establish baseline data for assessing the effectiveness of the drug and the occurrence of any adverse effects associated with drug therapy.*
- Assess the skin color and lesions *to monitor for adverse effects of the drug.*
- Monitor respirations and adventitious sounds *to evaluate drug effectiveness.*
- Assess the patency of nares *to determine the efficacy of inhaled preparations.*
- Evaluate orientation *to monitor adverse effects and headache.*
- Evaluate liver and renal function tests *to assess for potential problems with drug metabolism or excretion.*

Nursing Diagnoses

Nursing diagnoses related to drug therapy might include the following:

- Acute Pain related to local effects, headache, or GI effects
- Risk for Injury related to CNS effects
- Deficient Knowledge regarding drug therapy

Implementation With Rationale

- Review administration procedures with the patient periodically; *proper use of the delivery device is important in maintaining the effectiveness of this drug.*
- Caution the patient not to discontinue use abruptly; cromolyn should be tapered slowly if discontinuation is necessary *to prevent rebound adverse effects.*
- Instruct the patient taking cromolyn that this drug cannot be used during an acute attack *because it has no immediate effects on the airways.*

- Caution the patient to continue taking this drug, even during symptom-free periods, *to ensure therapeutic levels of the drug.*
- Advise the patient not to wear soft contact lenses; if cromolyn eye drops (used for allergic reactions) are used, *lenses can be stained or warped.*
- Provide thorough patient teaching, including the drug name and prescribed dosage, measures to help avoid adverse effects, warning signs that may indicate problems, and the need for periodic monitoring and evaluation, *to enhance patient knowledge about drug therapy and to promote compliance.*
- Offer support and encouragement *to help the patient cope with the disease and the drug regimen.*

Evaluation

- Monitor patient response to the drug (improved breathing, relief of signs of allergic disorders).
- Monitor for adverse effects (drowsiness, dizziness, headache, GI upset, local irritation).
- Evaluate the effectiveness of the teaching plan (patient can name drug, dosage, adverse effects to watch for, specific measures to avoid them, and measures to take to increase the effectiveness of the drug).
- Monitor the effectiveness of other measures to ease breathing.

KEY POINTS

- Corticosteroids decrease the inflammatory response. The inhalable form is associated with many fewer systemic effects than are the other corticosteroid formulations.
- To block various signs and symptoms of asthma, the leukotriene receptor antagonists block or antagonize receptors for the production of leukotrienes D_4 and E_4.
- The mast cell stabilizer cromolyn blocks the release of histamine and other chemicals associated with an allergic reaction. This decreases the inflammatory reaction in the airways.

LUNG SURFACTANTS

Lung surfactants (Table 55.5) are naturally occurring compounds or lipoproteins containing lipids and apoproteins that reduce the surface tension within the alveoli, allowing expansion of the alveoli for gas exchange. Three lung surfactants available for use are beractant (*Survanta*), calfactant (*Infasurf*), and the newest drug, poractant (*Curosurf*).

Therapeutic Actions and Indications

These drugs are used to replace the surfactant that is missing in the lungs of neonates with RDS (see Figure 55.2). See Table 55.5 for usual indications.

Pharmacokinetics

These drugs are instilled directly into the trachea and begin to act immediately on instillation. They are metabolized in the lungs by the normal surfactant metabolic pathways.

Contraindications and Cautions

Because lung surfactants are used as emergency drugs in the newborn, there are no contraindications.

Adverse Effects

Adverse effects that are associated with the use of lung surfactants include patent ductus arteriosus, bradycardia, hypotension, intraventricular hemorrhage, pneumothorax, pulmonary air leak, hyperbilirubinemia, and sepsis. These effects may be related to the immaturity of the patient, the invasive procedures used, or reactions to the lipoprotein.

TABLE 55.5 DRUGS IN FOCUS Lung Surfactants

Drug Name	Usual Dosage	Usual Indications
beractant (*Survanta*)	4 mL/kg birth weight, instilled intratracheally, may repeat up to four times in 48 h	Rescue treatment of infants who have respiratory distress syndrome (RDS); prophylactic treatment of infants at high risk for development of RDS (birth weight of <1,350 g; birth weight >1,350 g who have evidence of respiratory immaturity)
calfactant (*Infasurf*)	3 mg/kg birth weight, as soon as possible for prophylaxis; 3 mg/kg birth weight, divided into two doses, repeat up to a total of three doses 12 h apart, for rescue; instilled into trachea	Rescue treatment of infants who have RDS; prophylactic treatment of infants at high risk for RDS (see prior entry for risks)
poractant (*Curosurf*)	2.5 mL/kg birth weight, intratracheally, half in each bronchus, may repeat with up to two 1.25-mL/kg doses at 12-h intervals	Rescue treatment of infants who have RDS; this drug is being tried in the treatment of adult RDS and with adults after near-drowning

Prototype Summary: *Beractant*

Indications: Prophylactic treatment of infants at high risk for developing RDS; rescue treatment of infants who have developed RDS.

Actions: Natural bovine compound of lipoproteins that reduce the surface tension and allow expansion of the alveoli; replaces the surfactant that is missing in infants with RDS.

Pharmacokinetics:

Route	Onset	Peak
Intratracheal	Immediate	Hours

$T_{1/2}$: Unknown; metabolized by surfactant pathways.

Adverse effects: Patent ductus arteriosus, intraventricular hemorrhage, hypotension, bradycardia, pneumothorax, pulmonary air leak, pulmonary hemorrhage, apnea, sepsis, infection.

Nursing Considerations for Patients Receiving Lung Surfactants

Assessment: History and Examination

- Assess for *possible contraindications or cautions*: screen for time of birth and exact weight *to determine appropriate doses.* Because this drug is used as an emergency treatment, there are no contraindications to screen for.
- Perform a physical examination *to establish baseline data for assessing the effectiveness of the drug and the occurrence of any adverse effects associated with drug therapy.*
- Assess the skin temperature and color *to evaluate perfusion.*
- Monitor respirations, adventitious sounds, endotracheal tube placement and patency, and chest movements *to evaluate the effectiveness of the drug and drug delivery.*
- Evaluate blood pressure, pulse, and arterial pressure *to monitor the status of the infant.*
- Evaluate blood gases and oxygen saturation *to monitor drug effectiveness.*
- Assess temperature and complete blood count *to monitor for sepsis.*

Nursing Diagnoses

Nursing diagnoses related to drug therapy might include the following:

- Decreased Cardiac Output related to cardiovascular and respiratory effects of the drug
- Risk for Injury related to prematurity and risk of infection
- Ineffective Airway Clearance related to the possibility of mucus plugs
- Deficient Knowledge regarding drug therapy (for parents)

Implementation With Rationale

- Monitor the patient continuously during administration and until stable *to provide life support measures as needed.*
- Ensure proper placement of the endotracheal tube with bilateral chest movement and lung sounds *to provide adequate delivery of the drug.*
- Have staff view the manufacturer's teaching video before regular use *to review the specific technical aspects of administration.*
- Suction the infant immediately before administration, but do not suction for 2 hours after administration unless clinically necessary, *to allow the drug time to work.*
- Provide support and encouragement to parents of the patient, explaining the use of the drug in the teaching program, *to help them cope with the diagnosis and treatment of their infant.*
- Continue other supportive measures related to the immaturity of the infant *because this is only one aspect of medical care needed for premature infants.*

Evaluation

- Monitor patient response to the drug (improved breathing, alveolar expansion).
- Monitor for adverse effects (pneumothorax, patent ductus arteriosus, bradycardia, sepsis).
- Evaluate the effectiveness of the teaching plan, and support parents as appropriate.
- Monitor the effectiveness of other measures to support breathing and stabilize the patient.
- Evaluate the effectiveness of other supportive measures related to the immaturity of the infant.

KEY POINTS

- Lung surfactants are naturally occurring compounds that reduce the surface tension in the alveoli, allowing them to expand. They are injected directly into the trachea of infants who have respiratory distress syndrome.
- Administration of lung surfactants requires proper placement of the endotracheal tube, suctioning of the infant before administration (but not for 2 hours after administration unless necessary), and careful monitoring and support of the infant to ensure lung expansion and proper oxygenation.

OTHER DRUGS USED TO TREAT LOWER RESPIRATORY TRACT DISORDERS

The other major pathophysiology that can af fect the lo wer respiratory tract is infection. Infection can manifest as bronchitis or pneumonia. These infections occur when pathogens are able to enter the normally well-protected airways and surrounding tissue. Stress, age, and concurrent respiratory dysfunction all increase the opportunities for these pathogens to invade the respiratory tract and cause problems. These infections can be viral, bacterial, fungal, or protozoal in origin. They are treated using the appropriate agents to af fect the specific pathogen that is i volved. See Chapter 9 for drugs used to treat bacterial infections, Chapter 10 for drugs used to treat viral infections, Chapter 11 for drugs used to treat fungal infection, and Chapter 12 for drugs used to treat protozoal

infections. P atients with infections of the respiratory tract may have difficulty breathing decreased oxygenation leading to fatigue, and changes in abilities to carry on the activities of daily living, including eating. These patients require support, assistance to maintain function, help with nutrition, and support to deal with the uncomfortable feeling of not being able to breathe.

CHAPTER SUMMARY

- Pulmonary obstructive diseases include asthma, emphysema, and chronic obstructive pulmonary disease (COPD), which cause obstruction of the major airways, and respiratory distress syndrome (RDS), which causes obstruction at the alveolar level.
- Drugs used to treat asthma and COPD include drugs to block inflammation and drugs to dilate bronchi
- The xanthine derivatives have a direct effect on the smooth muscle of the respiratory tract, both in the bronchi and in the blood vessels.
- The adverse effects of the xanthines are directly related to the theophylline concentration in the blood and can progress to coma and death.
- Sympathomimetics are drugs that mimic the effects of the sympathetic nervous system; they are used for dilation of the bronchi and to increase the rate and depth of respiration.
- Anticholinergics can be used as bronchodilators because of their effect on the vagus nerve, resulting in relaxation of smooth muscle in the bronchi, which leads to bronchodilation.
- Steroids are used to decrease the inflammatory response i the airway. Inhaling the steroid tends to decrease the numerous systemic effects that are associated with steroid use.
- Leukotriene receptor antagonists block or antagonize receptors for the production of leukotrienes D_4 and E_4, thus blocking many of the signs and symptoms of asthma.
- The mast cell stabilizer cromolyn is an antiasthmatic drug that blocks mediators of inflammation and helps t decrease swelling and blockage in the airways.
- Lung surfactants are instilled into the respiratory system of premature infants who do not have enough surfactant to ensure alveolar expansion.

WEB LINKS

Health care providers and patients may want to consult the following Internet sources:

http://copd.20m.com
Information on living with COPD, aimed at patients and families.

http://www.nhlbi.nih.gov/health/dci/Diseases/Asthma/Asthma_WhatIs.html
Information on support groups, treatment programs, resources, and research involving COPD and asthma.

http://www.lungusa.org/index.html
Information on lung diseases, community support groups, getting involved, treatment, research, and definitions

www.cdc.gov/asthma/
Information on living with asthma, prevention, and treatment.

CHECK YOUR UNDERSTANDING

Answers to the questions in this chapter can be found in Answers to Check Your Understanding Questions on the CD-ROM accompanying this book.

MULTIPLE CHOICE

Select the best answer to the following.

1. Treatment of obstructive pulmonary disorders is aimed at
   a. opening the conducting airways or decreasing the effects of inflammation.
   b. blocking the autonomic reflexes that alter respirations.
   c. blocking the effects of the immune and inflammatory systems.
   d. altering the respiratory membrane to increase the flow of oxygen and carbon dioxide.

2. The xanthines
   a. block the sympathetic nervous system.
   b. stimulate the sympathetic nervous system.
   c. directly affect the smooth muscles of the respiratory tract.
   d. act in the CNS to cause bronchodilation.

3. Your patient has been maintained on theophylline for many years and has recently taken up smoking. The theophylline levels in this patient would be expected to
   a. rise, because nicotine prevents the breakdown of theophylline.
   b. stay the same, because smoking has no effect on theophylline.
   c. fall, because the nicotine stimulates liver metabolism of theophylline.
   d. rapidly reach toxic levels.

4. A person with hypertension and known heart disease has frequent bronchospasms and asthma attacks that are most responsive to sympathomimetic drugs. This patient might be best treated with
   a. an inhaled sympathomimetic to decrease systemic effects.
   b. a xanthine.
   c. no sympathomimetics because they would be contraindicated.
   d. an anticholinergic.

5. A patient with many adverse reactions to drugs is tried on an inhaled steroid for treatment of bronchospasm. For the first 3 days, the patient does not notice any improvement. You should
   a. switch the patient to a xanthine.
   b. encourage the patient to continue the drug for 2 to 3 weeks.
   c. switch the patient to a sympathomimetic.
   d. try the patient on surfactant.

6. Leukotriene receptor antagonists act to block production of a component of SRSA. They are most beneficial in treating
   a. seasonal rhinitis.
   b. pneumonia.
   c. COPD.
   d. asthma.

7. Respiratory distress syndrome occurs in
   a. babies with frequent colds.
   b. babies with genetic allergies.
   c. premature and low-birth-weight babies.
   d. babies stressed during the pregnancy.

8. Lung surfactants used therapeutically are
   a. injected into a developed muscle.
   b. instilled via a nasogastric tube.
   c. injected into the umbilical artery.
   d. instilled into an endotracheal tube properly placed in the baby's lungs.

Multiple Response

Select all that apply.

1. Clients who are using inhalers require careful teaching about which of the following?
   a. Avoiding food 1 hour before and 2 hours after dosing
   b. Storage of the drug
   c. Administration techniques to promote therapeutic effects and avoid adverse effects
   d. Lying flat for as long as 2 hours after dosing
   e. Timing of administration
   f. The difference between rescue treatment and prophylaxis

2. A child with repeated asthma attacks may be treated with which of the following drugs?
   a. A leukotriene receptor antagonist
   b. A beta-blocker
   c. An inhaled corticosteroid
   d. An inhaled beta-agonist
   e. A surfactant
   f. A mast cell stabilizer

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