## DRUG THERAPY

Two major groups of drugs used to treat asthma, acute and chronic bronchitis, and emphysema are bronchodilators and anti-inflammatory drugs. Bronchodilators are used to prevent and treat bronchoconstriction; anti-inflammatory drugs are used to prevent and treat inflammation of the airways. Reducing inflammation also reduces bronchoconstriction by decreasing mucosal edema and mucus secretions that narrow airways and by decreasing airway hyperreactivity to various stimuli. The drugs are described in the following sections; pharmacokinetic characteristics of inhaled drugs are listed in Table 47–1 and dosage ranges are listed in Drugs at a Glance: Bronchodilating Drugs and Drugs at a Glance: Anti-inflammatory Antiasthmatic Drugs.

### Bronchodilators

#### *Adrenergics*

Adrenergic drugs (see Chap. 18) stimulate beta$_2$-adrenergic receptors in the smooth muscle of bronchi and bronchioles. The receptors, in turn, stimulate the enzyme adenyl cyclase to increase production of cyclic AMP. The increased cyclic AMP produces bronchodilation. Some beta-adrenergic drugs (eg, epinephrine) also stimulate beta$_1$-adrenergic receptors in the heart to increase the rate and force of contraction. Cardiac stimulation is an adverse effect when the drugs are given for bronchodilation. These drugs are contraindicated in clients with cardiac tachydysrhythmias and severe coronary artery disease; they should be used cautiously in clients with hypertension, hyperthyroidism, diabetes mellitus, and seizure disorders.

**Epinephrine** may be injected subcutaneously in an acute attack of bronchoconstriction, with therapeutic effects in approximately 5 minutes and lasting for approximately 4 hours. However, an inhaled selective beta$_2$ agonist is the drug of choice in this situation. Epinephrine is also available without prescription in a pressurized aerosol form (eg, Primatene). Almost all over-the-counter aerosol products promoted for use in asthma contain epinephrine. These products are often abused and may delay the client from seeking medical attention. Clients should be cautioned that excessive use may produce hazardous cardiac stimulation and other adverse effects.

**Albuterol**, **bitolterol, levalbuterol,** and **pirbuterol** are short-acting beta$_2$-adrenergic agonists used for prevention and treatment of bronchoconstriction. These drugs act more selectively on beta$_2$ receptors and cause less cardiac stimulation than epinephrine. Most often taken by inhalation, they are also the most effective bronchodilators and the treatment of first choice to relieve acute asthma. Because the drugs can be effectively delivered by aerosol or nebulization, even to young children and patients on mechanical ventilation, there is seldom a need to give epinephrine or other nonselective adrenergic drugs by injection.

The beta$_2$ agonists are usually self-administered by metered-dose inhalers (MDIs). Although most drug references still list a regular dosing schedule (eg, every 4 to 6 hours), asthma experts recommend that the drugs be used when needed (eg, to treat acute dyspnea or prevent dyspnea during exercise). If these drugs are overused, they lose their bronchodilating effects because the beta$_2$-adrenergic receptors become unresponsive to stimulation. This tolerance does not occur with the long-acting beta$_2$ agonists.

**Formoterol and salmeterol** are long-acting beta$_2$-adrenergic agonists used only for *prophylaxis* of acute bronchoconstriction. They are not effective in acute attacks because they have a slower onset of action than the short-acting drugs (up to 20 minutes for salmeterol). Effects last

TABLE 47–1 **Pharmacokinetics of Selected Inhaled Antiasthma Medications**

| | Action | | | | |
|---|---|---|---|---|---|
| **Generic Name** | Onset (min) | Peak (hours) | Duration (hours) | **Metabolism/Excretion** | **Half-life (hours)** |
| ***Adrenergics*** | | | | | |
| **Albuterol** | 5 | 1.5–2 | 3–6 | Liver/urine | 2–4 |
| **Bitolterol** | 2–4 | 0.5–2 | 5–8 | Liver/lungs | 3 |
| **Levalbuterol** | 5 | 1 | 6–8 | Liver/urine | 4–6 |
| **Pirbuterol** | 5 | | 5 | Liver, tissue/urine | ND |
| **Salmeterol** | 13–20 | 3–4 | 7.5–17 | Liver/feces | ND |
| ***Anticholinergic*** | | | | | |
| **Ipratropium** | 15 | 1–2 | 3–4 | | 1.6 |
| ***Corticosteroids*** | | | | | |
| **Beclomethasone** | Rapid | 1–2 wks | | Liver/feces | 3–15 |
| **Budesonide** | Immediate | Rapid | 8–12 | Liver/urine (60%) & feces | 2.8 |
| **Flunisolide** | Slow | 10–30 | 4–6 | Liver/renal (50%), feces (40%) | 1–2 |
| **Fluticasone** | Slow | | 24 | Liver/feces & urine | 3.1 |

ND, not determined.