

Medications Affecting The Respiratory System

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Airflow Disorders

Overview

- Asthma is a chronic inflammatory disorder of the airways. It is an intermittent and reversible airflow obstruction that affects the bronchioles. The obstruction occurs either by inflammation or airway hyper-responsiveness leading to bronchoconstriction.

- Medication management usually addresses both inflammation and bronchoconstriction. These same medications may be used in symptomatic treatment of chronic obstructive pulmonary disease (COPD).

Medications include

- Bronchodilator agents such as beta2-adrenergic agonists, methylxanthines, inhaled anticholinergics, and anti-inflammatory agents such as glucocorticoids, mast cell stabilizers, and leukotriene modifiers.

Beta₂-Adrenergic Agonists

Select Prototype Medication

- Albuterol (Proventil, Ventolin)

Other Medications:

- Formoterol (Foradil Aerolizer)
- Salmeterol (Serevent)
- Terbutaline (Brethine)

Expected Pharmacological Action

Beta2-adrenergic agonists act by selectively activating the beta2-receptors in the bronchial smooth muscle, resulting in bronchodilation. As a result of this:

- Bronchospasm is relieved.
- Histamine release is inhibited.
- Ciliary motility is increased.

Therapeutic Uses

MEDICATION	ROUTE	THERAPEUTIC USES
Albuterol (Proventil, Ventolin)	<ul style="list-style-type: none">• Inhaled, short-acting• Oral, long-acting	<ul style="list-style-type: none">• Prevention of asthma attack (exercise-induced)• Treatment for ongoing asthma attack• Long-term control of asthma
Formoterol (Foradil Aerolizer) Salmeterol (Serevent)	<ul style="list-style-type: none">• Inhaled, long-acting	<ul style="list-style-type: none">• Long-term control of asthma
Terbutaline (Brethine)	<ul style="list-style-type: none">• Oral, long-acting	<ul style="list-style-type: none">• Long-term control of asthma

Side/Adverse Effects

SIDE/ADVERSE EFFECTS	NURSING INTERVENTIONS/CLIENT EDUCATION
Inhaled agents (short and long acting) have minimal adverse effects.	
Oral agents can cause tachycardia and angina because of activation of α_1 receptors in the heart	<ul style="list-style-type: none">• Advise clients to observe for signs and symptoms (chest, jaw, or arm pain or palpitations) and to notify the provider if they occur.• Instruct clients on how to check pulse and to report an increase of greater than 20 to 30 beats/min.• Advise clients to avoid caffeine.• Dosage may need to be lowered.
Tremors caused by activation of β_2 receptors in skeletal muscle	<ul style="list-style-type: none">• Tremors usually resolve with continued medication use.• Dosage may need to be reduced.

Contraindications/Precautions

- Beta2-adrenergic agonists are Pregnancy Risk Category C.
- These agents are contraindicated in clients with tachydysrhythmia.
- Use cautiously in clients who have diabetes, hyperthyroidism, heart disease, hypertension, and angina.

Interactions

MEDICATION/FOOD INTERACTIONS	NURSING INTERVENTIONS/CLIENT EDUCATION
Use of beta-adrenergic blockers (propranolol) can negate effects of both medications.	<ul style="list-style-type: none">• Beta-adrenergic blockers should not be used concurrently.
MAOIs and tricyclic antidepressants can increase the risk of tachycardia and angina.	<ul style="list-style-type: none">• Instruct clients to report changes in heart rate and chest pain.

Nursing Administration

- Instruct clients to follow manufacturer's instructions for use of device: metered-dose inhaler (MDI), dry-powder inhaler(DPI), and nebulizer.
- When a client is prescribed an inhaled beta2-agonist and an inhaled glucocorticoid, advise the client to inhale the beta2-agonist before inhaling the glucocorticoid. The beta2-agonist promotes bronchodilation and enhances absorption of the glucocorticoid.
- Advise clients not to exceed prescribed dosages.
- Ensure that clients know the appropriate dosage schedule (if the medication is to be taken on a fixed or a when-necessary schedule).

Nursing Administration

- Formoterol and salmeterol are both long-acting beta2-agonist inhalers. These inhalers are used every 12 hr for long-term control and are not to be used to abort an asthma attack. A short-acting beta2-agonist should be used if clients need to treat an acute attack.
- Advise clients to observe for signs of an impending asthma attack and to keep a log of the frequency and intensity of attacks.
- Instruct clients to notify the provider if there is an increase in the frequency and intensity of asthma attacks.

Nursing Evaluation of Medication Effectiveness

- Long-term control of asthma attacks.
- Prevention of exercise-induced asthma attack.
- Resolution of asthma attack as evidenced by absence of shortness of breath, clear breath sounds, absence of wheezing, return of respiratory rate to baseline.

Methylxanthines

Select Prototype Medication:

- Theophylline (Theolair, Theo-24)

Expected Pharmacological Action

- Theophylline causes relaxation of bronchial smooth muscle, resulting in bronchodilation.

Therapeutic Uses

- Oral theophylline is used for long-term control of chronic asthma.
- Route of administration: oral or IV (emergency use only)

Side/Adverse Effects

SIDE/ADVERSE EFFECTS	NURSING INTERVENTIONS/CLIENT EDUCATION
<ul style="list-style-type: none">• Mild toxicity reaction may include GI distress and restlessness.• More severe reactions can occur with higher therapeutic levels and can include dysrhythmias and seizures	<ul style="list-style-type: none">• Monitor theophylline serum levels to keep within therapeutic range (5 to 15 mcg/mL). Side effects are unlikely to occur at levels less than 20 mcg/mL.• If symptoms occur, stop the medication. If necessary, activated charcoal can be used to decrease absorption, lidocaine can be used to treat dysrhythmias, and diazepam can be used to control seizures.• Instruct client that periodic blood levels will be needed. Advise client to report any symptoms of nausea, diarrhea, or restlessness that may indicate toxicity.

Contraindications/Precautions

- Pregnancy Risk Category C
- Use cautiously in clients who have heart disease, hypertension, liver and renal dysfunction, and diabetes.
- Use cautiously in children and older adults.

Interactions

MEDICATION/FOOD INTERACTIONS	NURSING INTERVENTIONS/CLIENT EDUCATION
<ul style="list-style-type: none">• Caffeine increases CNS and cardiac adverse effects of theophylline.• Caffeine can also increase theophylline levels.	<ul style="list-style-type: none">• Advise clients to avoid consuming caffeinated beverages (coffee, caffeinated colas).
<ul style="list-style-type: none">• Phenobarbital and phenytoin decrease theophylline levels.	<ul style="list-style-type: none">• When theophylline is used concurrently with these medications, increase the dosage of theophylline.
<ul style="list-style-type: none">• Cimetidine (Tagamet), ciprofloxacin (Cipro), and other fluoroquinolone antibiotics increase theophylline levels.	<ul style="list-style-type: none">• When theophylline is used concurrently with these medications, decrease the dosage of theophylline.

Nursing Administration

- Advise clients to take the medication as prescribed. If a dose is missed, the following dose should not be doubled.
- Instruct clients not to chew or crush sustained-release preparations. These medications should be swallowed whole.

Nursing Evaluation of Medication Effectiveness

- Long-term control of asthma attacks

INHALED ANTICHOLINERGICS

Select Prototype Medication

- Ipratropium (Atrovent)

Other Medications

- Tiotropium (Spiriva)

Expected Pharmacological Action

- These medications block muscarinic receptors of the bronchi, resulting in bronchodilation.

Therapeutic Uses

- These medications are used to relieve bronchospasm associated with chronic obstructive pulmonary disease.
- These medications are used for allergen-induced and exercise-induced asthma.
- Route of administration: inhalation.

Complications

SIDE/ADVERSE EFFECTS	NURSING INTERVENTIONS/CLIENT EDUCATION
Local anticholinergic effects (dry mouth, hoarseness)	Advise clients to sip fluids and suck on hard candies to control dry mouth.

Contraindications/Precautions

- Inhaled anticholinergics are Pregnancy Risk Category B.
- These agents are contraindicated in clients who have an allergy to peanuts because the medication preparations may contain soy lecithin.
- Use cautiously in clients who have narrow-angle glaucoma and benign prostatic hypertrophy (due to anticholinergic effects).

Nursing Administration

- Advise clients to rinse the mouth after inhalation to decrease unpleasant taste.
- Usual adult dosage is two puffs. Instruct clients to wait the length of time directed between puffs.
- If clients are prescribed two inhaled medications, instruct clients to wait at least 5 min between medications.

Nursing Evaluation of Medication Effectiveness

- Control of bronchospasm in clients with chronic obstructive pulmonary disease
- Prevention of allergen-induced and exercise-induced asthma attack

GLUCOCORTICOIDS

Select Prototype Medication:

- Inhalation: beclomethasone dipropionate (QVAR)
- Oral: prednisone (Deltasone)

Other Medications:

Inhalation:

- Budesonide (Pulmicort Flexhaler)
- Fluticasone propionate and salmeterol (Advair)
- Fluticasone propionate (Flovent)
- Triamcinolone acetonide (Azmacort)

- **Oral:** Prednisolone (Prelone)
- **IV:**
- Hydrocortisone sodium succinate (Solu-Cortef)
- Methylprednisolone sodium succinate (Solu-Medrol)

Expected Pharmacological Action

- These medications prevent inflammation, suppress airway mucus production, and promote responsiveness of beta2 receptors in the bronchial tree.
- The use of glucocorticoids does not provide immediate effects, but rather promotes decreased frequency and severity of exacerbations and acute attacks.

Therapeutic Uses

- Short-term IV agents are used for status asthmaticus.
- Inhaled agents are used for long-term prophylaxis of asthma.
- Short-term oral therapy is used to treat symptoms following an acute asthma attack.
- Long-term oral therapy is used to treat chronic asthma.
- Replacement therapy is used for primary adrenocortical insufficiency.
- Promote lung maturity and decrease respiratory distress in fetuses at risk for preterm birth.

Complications

SIDE/ADVERSE EFFECTS	NURSING INTERVENTIONS/CLIENT EDUCATION
Beclomethasone dipropionate	
Difficulty speaking, hoarseness, and candidiasis	<ul style="list-style-type: none">• Advise clients to use a spacer with MDI.• Advise clients to rinse mouth or gargle with water or salt water after use.• Advise clients to monitor for redness, sores, or white patches and to report to provider if they occur. Candidiasis may be treated with nystatin oral suspension.

Prednisone when used for 10 days or more can result in:

<p>Suppression of adrenal gland function, such as a decrease in the ability of the adrenal cortex to produce glucocorticoids: Can occur with inhaled agents and oral agents</p>	<ul style="list-style-type: none"> • Administer oral glucocorticoid on an alternate-day dosing schedule. • Monitor the client's blood glucose levels. • Taper the client's dose.
<p>Bone loss (can occur with inhaled agents and oral agents)</p>	<ul style="list-style-type: none"> • Advise clients to perform weight-bearing exercises. • Advise clients to consume a diet with sufficient calcium and vitamin D intake. • Use the lowest dose possible to control symptoms. • Oral medications should be given on an alternate-day dosing schedule.
<p>Hyperglycemia and glucosuria</p>	<ul style="list-style-type: none"> • Clients with diabetes should have their blood glucose monitored. • Clients may need an increase in insulin dosage.
<p>Myopathy as evidenced by muscle weakness</p>	<ul style="list-style-type: none"> • Instruct clients to report signs of muscle weakness. • Medication dosage should be decreased.
<p>Peptic ulcer disease</p>	<ul style="list-style-type: none"> • Advise clients to avoid NSAIDs. • Advise clients to report black, tarry stools. Check stool for occult blood periodically. • Administer with food or meals.
<p>Infection</p>	<ul style="list-style-type: none"> • Advise clients to notify the provider if early signs of infection occur (sore throat, weakness, malaise).
<p>Disturbances of fluid and electrolytes (fluid retention as evidenced by weight gain, and edema and hypokalemia as evidenced by muscle weakness)</p>	<ul style="list-style-type: none"> • Instruct clients to observe for symptoms and report to the provider.

Contraindications/Precautions

- Pregnancy risk category C
- Contraindicated in clients who have received a live virus vaccine
- Contraindicated in clients with systemic fungal infections
- Use cautiously in children, and in clients who have diabetes, hypertension, peptic ulcer disease, and/or renal dysfunction.
- Use cautiously in clients taking NSAIDs.

Interactions

MEDICATION/FOOD INTERACTIONS	NURSING INTERVENTIONS/CLIENT EDUCATION
Prednisone	
Concurrent use of potassium-depleting diuretics increases the risk of hypokalemia.	<ul style="list-style-type: none">• Monitor potassium level and administer supplements as needed.
Concurrent use of NSAIDs increases the risk of GI ulceration.	<ul style="list-style-type: none">• Advise clients to avoid use of NSAIDs. If GI distress occurs, instruct clients to notify the provider.
Concurrent use of glucocorticoids and hypoglycemic agents (oral and insulin) will counteract the effects.	<ul style="list-style-type: none">• Clients should notify the provider if hyperglycemia occurs. The client may need increased dosage of insulin or oral hypoglycemics.

Nursing Administration

- Instruct clients to use glucocorticoid inhalers on a regular, fixed schedule for long-term therapy of asthma. Glucocorticoids are not to be used to treat an acute attack.
- Administer using an MDI device, DPI, or nebulizer.
- When a client is prescribed an inhaled beta2-agonist and an inhaled glucocorticoid, advise the client to inhale the beta2-agonist before inhaling the glucocorticoid. The beta2-agonist promotes bronchodilation and enhances absorption of the glucocorticoid.
- Oral glucocorticoids are used short-term, 3 to 10 days following an acute asthma attack.
- If client is on long-term oral therapy, additional dosages of oral glucocorticoids are required in times of stress (infection, trauma).
- Clients who discontinue oral glucocorticoid medications or switch from oral to inhaled agents require additional doses of glucocorticoids during periods of stress.

Nursing Evaluation of Medication Effectiveness

- Long-term control of asthma attacks
- Resolution of acute attack as demonstrated by absence of shortness of breath, clear breath sounds, absence of wheezing, and return of respiratory rate to baseline

Mast Cell Stabilizers (Anti-inflammatory)

Select Prototype Medication

- Cromolyn sodium (Intal)
- Other Medication: nedocromil sodium (Tilade)

Expected Pharmacological Action

Anti-inflammatory action

- These medications stabilize mast cells, which inhibits the release of histamine and other inflammatory mediators.
- These medications suppress inflammatory cells (eosinophils, macrophages).

Therapeutic Uses

- Management of chronic asthma
- Prophylaxis of exercise-induced asthma
- Prevention of allergen-induced attack
- Allergic rhinitis by intranasal route
- Route of administration: inhalation

Side/Adverse Effects

- Safest of all asthma medications
- Safe to use for children

Contraindications/Precautions

- These agents are Pregnancy Risk Category B.
- Fluorocarbons in aerosols make this medication contraindicated for clients who have coronary artery disease, dysrhythmias, and status asthmaticus.
- Use cautiously in clients with liver and kidney impairment.

Nursing Administration

- Advise clients to take medication 15 min before exercise or exposure to allergen.
- Advise clients that long-term prophylaxis may take several weeks for full therapeutic effects to be established.
- Advise clients that this is not a bronchodilator and is not intended for aborting an asthmatic attack.
- Instruct clients in the proper use of administration devices (nebulizer, MDI).

Nursing Evaluation of Medication Effectiveness

- Prevention of exercise- or allergen-induced bronchospasm
- Decreased episodes of allergic rhinitis
- Long-term control of asthma

LEUKOTRIENE MODIFIERS

Select Prototype Medication

- Montelukast (Singulair)
- Other Medication: Zileuton (Zyflo), Zafirlukast (Accolate)

Expected Pharmacological Action

- Leukotriene modifiers prevent the effects of leukotrienes, thereby suppressing inflammation, bronchoconstriction, airway edema, and mucus production.

Therapeutic Uses

- Leukotriene modifiers are used for long-term therapy of asthma in adults and children 15 years and older and to prevent exercise-induced bronchospasm.
- Route of administration: oral

SIDE/ADVERSE EFFECTS

SIDE/ADVERSE EFFECTS

Liver injury with use of zileuton (Zyflo) and zafirlukast (Accolate)

NURSING INTERVENTIONS/CLIENT EDUCATION

- Obtain baseline liver function tests and monitor periodically.
- Advise clients to monitor for signs of liver damage (nausea, anorexia, abdominal pain).
- Instruct clients to notify the provider if symptoms occur.

Contraindications/Precautions

- Use cautiously in clients with liver dysfunction.

Interactions

MEDICATION/FOOD INTERACTIONS	NURSING INTERVENTIONS/CLIENT EDUCATION
Zileuton and zafirlukast inhibit metabolism of warfarin (Coumadin), leading to increased warfarin levels.	<ul style="list-style-type: none">• Advise clients to observe for signs of bleeding and to notify the provider.• Monitor prothrombin time (PT) and INR levels.
Zileuton and Zafirlukast inhibit metabolism of theophylline, leading to increased theophylline levels.	<ul style="list-style-type: none">• Monitor theophylline levels.• Advise clients to observe for signs of theophylline toxicity (nausea, vomiting, seizures), and to notify the provider.

Nursing Administration

- Advise clients to take zileuton as prescribed. Zileuton can be given with or without food.
- Advise clients that zafirlukast should not be given with food, and to administer it 1 hr before or 2 hr after meals.
- Advise clients to take montelukast once daily at bedtime.

Nursing Evaluation of Medication Effectiveness

- Long-term control of asthma

DOSAGES

Bronchodilators

DRUG (PREGNANCY CATEGORY)	PHARMACOLOGIC CLASS	USUAL DOSAGE RANGE	INDICATIONS
<ul style="list-style-type: none"> albuterol (Proventil, Proventil Repetabs, Ventolin, others) (C) 	Short-acting beta ₂ agonist (SABA)	<p>Pediatric 2-6 yr PO: 0.1-0.2 mg/kg 3 times daily</p> <p>Pediatric 7-11 yr PO: 2 mg 3-4 times daily</p> <p>Adult and pediatric 12 yr and older PO: 2-4 mg 3-4 times daily</p> <p>Adult and pediatric 4 yr and older MDI: 2 puffs q4-6h</p> <p>Inhalation solution: 2.5 mg 3-4 times daily</p>	Asthma, bronchospasm
ipratropium (Atrovent) (B)	Anticholinergic	<p>Adult and pediatric 12 yr and older MDI: 2 puffs 4 times daily</p> <p>Nasal spray, 0.03%: 2 sprays 2-3 times daily</p> <p>Nasal spray, 0.06%: 2 sprays 3-4 times daily</p> <p>Inhalation solution: 500 mcg 3-4 times daily</p>	
<ul style="list-style-type: none"> salmeterol* (Serevent) (C) 	Long-acting beta ₂ agonist (LABA)	<p>Adult 1 puff twice a day</p>	Asthma, COPD

DOSAGES

Theophylline Salts

DRUG (PREGNANCY CATEGORY)	PHARMACOLOGIC CLASS	USUAL DOSAGE RANGE	INDICATION
theophylline (Elixophyllin, Theo-Dur, Uniphyll, others) (C)	Xanthine-derived bronchodilator	Adult PO: 400-600 mg/day in 1-4 divided doses	Asthma

DOSAGES

Selected Antileukotriene Drug

DRUG (PREGNANCY CATEGORY)	PHARMACOLOGIC CLASS	USUAL DOSAGE RANGE	INDICATIONS
♦ montelukast (Singulair) (B)	Leukotriene receptor antagonist	Pediatric 2-5 yr 4 mg daily in evening Pediatric 6-14 yr 5 mg daily in evening Adult and pediatric 15 yr and older 10 mg daily in evening	Asthma (prophylaxis and maintenance treatment)

DOSAGES

Selected Corticosteroids

DRUG (PREGNANCY CATEGORY)	PHARMACOLOGIC CLASS	USUAL DOSAGE RANGE	INDICATIONS
fluticasone propionate (Flovent, Flonase) (C)	Synthetic glucocorticoid	Adult and pediatric 12 yr and older Flovent MDI, 3 strengths available: 88-880 mcg twice daily	Asthma (prophylaxis and maintenance treatment)
		Pediatric 4-11 yr Flovent inhalation powder, 3 strengths available: 50-100 mcg twice daily	
methylprednisolone (Solu-Medrol injection, Medrol tablets) (C)	Synthetic glucocorticoid	Adult and pediatric 12 yr and older Flovent inhalation powder, 3 strengths available: 100-1000 mcg twice daily	Seasonal allergic rhinitis
		Dosage varies as above, but usually 40-125 mg IV, 1-3 times daily, usually tapered down Oral taper: usually from 24 to 2 mg daily	Exacerbations of asthma or COPD

COPD, Chronic obstructive pulmonary disease; IV, intravenous; MDI, metered-dose inhaler.

CASE STUDY

Bronchodilators and Corticosteroids for COPD

Ms. B. is a 73-year-old woman who worked in the local traffic tunnel for about 25 years and has had chronic obstructive pulmonary disease (COPD) for 10 years, caused by exposure to environmental pollutants while on the job and by cigarette smoking. She is now retired and is frequently admitted to the hospital for treatment of her condition. She quit smoking about 8 years ago. Ms. B. is now in the hospital for treatment of an acute exacerbation of her COPD and an upper respiratory tract infection. The physician has ordered the following: Oxygen per nasal cannula at 2 L/min, methylprednisolone (Solu-Medrol), 125 mg IVPB, then 80 mg IVPB every 6 hours; Advair 50 mcg/250 mcg, 1 puff every 12 hours; albuterol (Accuneb) 2.5 mg by nebulizer every 4 hours for 2 days, then every 4 hours as needed; piperacillin/tazobactam (Zosyn) antibiotic therapy, 3.375 g intravenously every 6 hours; measurement of intake and output; daily weight measurement; assessment of vital signs with breath sounds and pulse oximetry every 2 hours until stable; chest physiotherapy twice a day and as needed.

- What is in Advair, and what does the “50 mcg/250 mcg” mean? Explain the class and purposes of the drug(s) it contains.

- Within 2 days, Ms. B's condition stabilizes, and the methylprednisolone dose is gradually reduced. After 1 week, the IV corticosteroid is discontinued and she is started on oral prednisone (generic) 40 mg daily. Her discharge medications include the following:
- prednisone (generic) 40 mg PO daily for 3 days, then taper and discontinue by reducing the dose by 5 mg daily. (Prescription calls for 5-mg tablets.)
- Advair 50 mcg/250 mcg, 1 puff every 12 hours.
- albuterol (Proventil HFA) metered-dose inhaler, 90 mcg/spray, every 4 hours as needed.

- What is the reason for tapering the methylprednisolone and prednisone before they are discontinued?
- Ms. B states, “This is confusing! How do I know how many tablets to take? It’s different each day!” What can you do to help her with the tapering dosage of prednisone?
- While going over the medications, Ms. B asks you, “So which inhaler do I take if I feel short of breath? The Advair or the albuterol? Aren’t they the same thing?” What is the nurse’s best response?