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February 2008 "Review of Asthma" 707-000-08-002-H01-P

THIS MONTH--
"Review of Asthma"

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Asthma is a common, costly public health issue in the U.S. It is a respiratory disorder characterized by recurring dyspnea caused by reversible smooth muscle contraction that narrows the airway lumen, limiting airflow, & resulting in coughing, wheezing & expectoration. Our goals are to review this disease & to discuss the treatment options. This lesson provides 1.25 hours (0.125 CEUs) of credit, and is intended for pharmacists in all practice settings. **The program ID # for this lesson is 707-000-08-002-H01-P. Pharmacists completing this lesson by February 28, 2011 may receive full credit.**

To obtain continuing education credit for this lesson, you must answer the questions on the quiz (70% correct required), and return the quiz. Should you score less than 70%, you will be asked to repeat the quiz. Computerized records are maintained for each participant.

If you have any comments, suggestions or questions, contact us at the above address, or call toll free 1-800-323-4305. (In Alaska and Hawaii phone 1-847-945-8050). **Please write your ID Number (the number that is on the top of the mailing label) in the indicated space on the quiz page** (for continuous participants only).

The objectives of this lesson are such that upon completion the participant will be able to:

1. Discuss the incidence of asthma in the U.S.
2. List the symptoms of asthma.
3. Relate the significance of environmental control in the management of asthma.
4. Comment upon the major adverse effects of the beta 2 agonists.
5. Discuss pharmacologic adjunct therapy used in the management of asthma

INTRODUCTION

Asthma is a disorder characterized by recurrent attacks of paroxysmal dyspnea accompanied by wheezing due to bronchospasm. It affects about 4-7% of the worldwide population. Over 12-17 million Americans (including 5 million children) are asthmatics. It appears that the incidence of asthma is higher among children and teenagers than among the older age groups. Frequently the symptoms become milder with age. Reports indicate that at least 50-70% of asthmatic children may become symptom free or experience much milder asthma by the time they become adults. However, a significant percentage continues to have symptoms of the disease. Urban populations are more prone to asthma and so are blacks and some Hispanics. In the U.S., over 5,000 deaths annually occur as a result of asthma, and approximately 500,000 persons are hospitalized annually. Morbidity rate is 5% higher among blacks than whites. The medical cost nationwide has been estimated to be over $15 billion.

ETIOLOGY

The exact cause of asthma is unknown, but several factors have been implicated in triggering this condition. It appears that heredity plays a role. It has been concluded that asthma attacks result from interaction between susceptibility genes (T-Helper2, their cytokines and ADAM 33 gene) and environmental factors. Such interaction may cause an increase in responsiveness of the bronchial tree and ultimately inflame the airway smooth muscle resulting in partially or completely reversible bronchoconstriction. Atopy as well as environmental factors (dust, pollen, occupational exposures, pollutants, and volatile organic solvents) and indoor allergens (dust mites, pets, mildew, roaches, sulfites, and drugs) have been implicated in the development of the disease. Drugs as well as diet deficient in vitamins C and E have been associated with causing asthma. Asthma can be aggravated by damp weather, respiratory tract infections and tobacco smoke.

PATHOPHYSIOLOGY

Cells such as T-helper1 (TH1) and T-helper2 (TH2) eosinophils, mast cells, neutrophils and macrophages cause diffuse inflammation of the epithelium and smooth muscle of the airways that ultimately result in desquamation, fibrosis, and hypertrophy. Such outcomes will cause narrowing of the airways and increased responsiveness of the bronchial tree to allergens, infections and pollutants. Formation of mucus, that tends to adhere to the walls of the bronchial tree, and peripheral blood eosinophils are complicating factors. Asthma attacks are triggered by factors such as inhalation of irritants (organic solvents, smoke), aspirin, anger, excitement, gastro esophageal reflux disease (GERD), allergic rhinitis and exercise, which may be caused by cooling and drying of the airways. The increased reactivity is characterized by constriction of the smooth muscles of the bronchial airways, overproduction of mucus plugging, mucosal edema resulting from inflammation, and desquamation of the airway epithelium and smooth muscle. Exposure to an allergen tends to cause degranulation of the mast cells, resulting in liberation of chemical mediators such as histamine, slow reacting substance of anaphylaxis and leukotrienes. Such mediators are responsible for bronchospasm, oversecretion of mucus, and edema.

SYMPTOMS AND SIGNS

Symptoms of asthma can be:

1. Mild and intermittent which are characterized by the occurrence of daytime symptoms twice or less every two days to weekly with brief exacerbation. Nighttime symptoms occur less than twice a month.
2. Mild persistent daytime symptoms that occur more than twice a week, but not daily. Exacerbation may result in interference with daily activity. Nighttime symptoms occur more than twice per month.

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3. Moderate persistent daytime symptoms that occur daily; whereas, nighttime symptoms occur more than once a week.
4. Severe persistent symptoms occur daily and continuously with frequent nighttime symptoms.

Patients with **mild** asthma are usually asymptomatic between attacks, but may experience mild dyspnea, some wheezing and cough. In **moderate** asthma, patients may complain of difficulty in breathing, chest tightness, noticeable wheezing, frequent coughing and mild tachycardia. **Severe** asthma is characterized by severe dyspnea, coughing, prominent wheezing, rapid shallow breathing, irritability, and cyanosis. Attacks are more severe during sleep & keep patients awake. Symptoms are usually continuous, & attacks become more severe during expiration & inspiration. Production of sputum is usually excessive & may trigger coughing that is relieved once sputum is expelled. The sputum is sticky, yellowish & contains eosinophils. Symptoms & signs usually disappear betweenattacks. However, some wheezing may become evident especially on forced expiration and during exercise. The vast majority of children outgrow the disease and become asymptomatic. About 25% of asthmatic children will continue to have wheezing until they reach adulthood or asthma may recur in later years. Persistence of asthma or its recurrence is usually triggered by factors such as smoking, pollution, sensitization to allergens as well as airway hyperreactivity. Inadequate treatment may lead to death. It has been speculated that most of the deaths that occur in the U.S. are due to improper treatment or lack of it. In time the lungs of some asthmatics may undergo anatomical changes that lead to abnormal functioning. Early and proper use of drugs as well as compliance to treatment may prevent such destructive changes in the airways.

TREATMENT

Asthmatics may use nonprescription drugs only after their condition has been diagnosed by a physician as being asthma, since there are conditions (acute or chronic bronchitis, emphysema, cardiac asthma, and bronchial infections) where symptoms resemble those of asthma. Furthermore, a dosage schedule of nonprescription drugs should be established by the physician. Goals of treatment for asthma are to prevent exacerbation of the disease, as well as to reduce chances of chronic and acute symptoms, maintain normal daily and pulmonary activities, avoidance of triggering factors, selection of drug treatment that fits the severity of the condition, observing the patient's response to the selected drugs, and avoidance or minimizing side effects of the drugs used. The major components of asthma management include environmental control and pharmacologic therapy.

Environmental Control involves avoidance of the triggering factors that result in symptoms of asthma. It is important to identify these factors and avoid or minimize contact with them. Allergens such as dust, home-dust mites, animal dander, roaches, mildew, pollen and pollutants should be avoided. The use of synthetic fiber pillows, along with frequent washing of bed sheets, blankets and pillow cases are recommended. Dust mites may be removed by steam treatment. Animal dander from pets must be minimized or eliminated. The use of dehumidifiers helps in keeping moisture low in poorly aerated areas in the home, thereby preventing the formation of mildew. Extermination of roaches is important in reducing or eliminating contact with such pests. Exposure to nonallergic factors such as tobacco smoke, fumes, strong odors, cold temperature, damp environment and excessive exercise should be avoided or reduced. The use of a high efficiency particulate air filter (HEPA) is helpful in removing many allergenic and nonallergenic triggers. Aggravating factors such as sulfite containing dried or packed fruits, fermented beverages (beer and wines), and various processed foods should be avoided. Treating exacerbating factors such as rhinitis, sinusitis and GERD is essential for reducing the severity of the condition. Medications (aspirin and NSAIDs) that may cause anaphylaxis or bronchospasm in sensitive patients should be avoided. Such patients can use acetaminophen, salicylate or cyclooxygenase (COX) - β2 inhibitors instead.

Pharmacologic Therapy is required by the vast majority of patients. Nonprescription drugs may be helpful and used in mild intermittent cases. Such medications may provide relief of mild shortness of breath, tightness in the chest and wheezing. The major limitations of these drugs include under treatment therapy which is considered a major cause of morbidity and mortality from asthma, absence of the use of anti-inflammatory therapies and failure to adhere to appropriate therapy. Following the diagnosis of the condition by a primary care provider the pharmacist can play an important role in patient education regarding the use of drugs, patient mon-

itoring, proper utilization of inhaled products, ensuring compliance by the patient and achieving an optimal asthma outcome for the patient. Nonprescription drugs for asthma are generally safe at recommended dosage and are effective in relieving shortness of breath due to bronchoconstriction. However, as stated earlier, such medications should be used only after the condition has been diagnosed and the dosage has been determined by a physician.

The main categories of prescription drugs used in the treatment of asthma and its exacerbation include: bronchodilators (β-agonists, anticholinergics), corticosteroids, mast cells stabilizers, leukotriene modifiers, and methylxanthines.

β-AGONISTS

These agents act by stimulating the β-receptors in the bronchial tree. Stimulation of β1- receptors (β1-agonists) result in bronchodilitation, as well as in an increase in heart rate. Selective β2-agonists primarily stimulate β2-receptors and results in relaxation of the smooth muscles, and stabilization of the mast cells. This prevents release of chemical mediators, a decrease in vascular permeability of the airway (reduce edema) and increases the removal of mucus by ciliary movement. Bronchospasm relief is achieved by utilization of β2-agonists that occurs due to stimulation of the enzyme adenylate cyclase, which in turn increases the intracellular concentration of cyclic adenosine monophosphate. β2-agonists are available as short and long-acting medications. Short-acting ones include albuterol, bitolterol, levalbuterol and pirbuterol; whereas, the long-acting ones include formoterol and salmeterol.

Albuterol is a selective, short-acting β2-agonist that is used orally or orally inhaled. Due to its selective activity, it rarely causes cardiac simulation. It is administered by oral inhalation for relief of bronchospasm in patients with reversible, obstructive bronchial tree asthma, as well as in the prevention of bronchoconstriction that may follow exercise. In addition to being orally inhaled, albuterol sulfate may be taken orally for the same symptoms of asthma. Albuterol is used as an initial therapy for asthmatics who complain of mild intermittent asthma, normally daytime attacks of no more than twice a week, and nighttime symptoms of not more than twice a month. Like other short–acting inhaled β2-agonists, albuterol may be used as pretreatment in asymptomatic asthma such as exercise induced asthma. The medication should be inhaled prior to exercise and as symptoms develop in patients suffering from mild intermittent asthma. Dosing may be as often as 3 or 4 times a day, if the mild asthma becomes more frequent. Administration of orally inhaled albuterol or albuterol sulfate about 15 minutes before exercising appears to prevent bronchospasm for up to 4 hours in most patients and up to 6 hours in about one third of patients who took the medication. Orally inhaled albuterol is administered by using a metered-dose inhaler, while albuterol sulfate is administered either by metered-dose inhaler or nebulizer. When a nebulizer is used, it is important for the patient to observe aseptic techniques in order to prevent microbial contamination. Extended release tablets of albuterol sulfate are available. Like all such tablets, they should not be chewed, crushed, or given with food. The dosage of both albuterol and albuterol sulfate should be determined in accordance with the patient's needs and responses to therapy. Each metered spray of oral inhaler contains 90 mcg of drug. For the relief or prevention of asthmatic symptoms, two inhalations containing about 180 mcg of albuterol should be administered every 4 to 6 hours. In some milder cases one inhalation (90 mcg) may be satisfactory. As a general rule, regular administration of short-acting β2-agonists (i.e. 4 times daily) in a maintenance dose is not recommended. However, such therapy may be used only for acute relief of bronchoconstriction or to prevent exercise induced bronchospasm. The usual adult initial dose of oral albuterol is 2 to 4 mg, 3 to 4 times daily in the form of regular tablets. Whereas, extended release tablets should be given in a dose range of 4 to 8 mg every 12 hours. Patients who do not respond positively to the initial dose may have their dose gradually increased to a maximum of 8 mg 4 times daily. If the patient experiences side effects, then a temporary reduction in dosage may be initiated in some patients. Once the adverse effect is reduced or disappears, a gradual incremental increase in the dose should be followed until the optimal dosage is reached.

The adverse effects of orally inhaled albuterol and albuterol sulfate as well as conventional and sustained release tablets are common. Oral tablets may cause transient side effects that are dose related and similar to those of other sympathomimetic medications, except selective β2-agents have less cardiovascular effect. The main side effects include tremor (which occurs in approximately 20% of patients receiving albuterol sulfate oral tablets or oral inhalation via nebulizer) anxiety, excitability, nausea, tachycardia, palpitations, chest pain,

dizziness, increased sweating, muscle cramps and conjunctivitis. It should be kept in mind that oral inhalation therapy with albuterol and other β2-agonists is for relief of acute asthma attacks and not for continuous maintenance therapy. If such acute attacks persist then other therapy should be instituted. The use of short-acting β2-agonists 4 or more times daily for 2 consecutive days is not warranted, and the patient should seek medical consultations. Frequent, excessive and prolonged use of some inhalers may lead to tolerance. Patients should consult with a physician, if the normal dose of albuterol becomes ineffective. Death from cardiac arrest has occurred when sympthomimetic amine oral inhalations were used excessively. Albuterol should not be used in patients who exhibit sensitivity to sympathomimetic drugs and in patients who suffer from diabetes, hyperthyroidism, seizure disorders, hypertension, cardiovascular conditions such as coronary insufficiency and cardiac arrhythmias.

Levalbuterol is a short-acting β2-agonist that is used via oral inhalation as a bronchodilator for relief of asthma symptoms as well as prevention of bronchoconstriction. It has activities, side effects and precautions similar to those of albuterol.

Formoterol is a sympathomimetic amine that is considered to be a selective, long-acting β2-agonist. It has therapeutic activity similar to that of albuterol except, the effect is longer. It is used for long-term prevention of bronchoconstriction in asthmatics with reversible obstruction of the airway. It is also used to relieve bronchospasm caused by chronic bronchitis and emphysema. It is recommended for asthmatics who require regular administration of short-acting β2-agonists. The new guidelines for the control of asthma call for the inclusion of a long-acting bronchodilator such as formoterol or salmeterol in treating patients whose asthma is persistent and does not respond to treatment with inhaled corticosteroid or intermittent use of a short-acting, inhaled β2-agonist. It should be kept in mind that formoterol is not a replacement therapy for corticosteroids. Furthermore, it is recommended that when using formoterol, corticosteroid therapy should be continued. Long-acting β2-agonist inhalation therapy is recommended for asthmatics who complain of moderate persistent attacks and daily symptoms are inadequately controlled by the inclusion of inhaled corticosteroids with short–acting inhaled β2-agonists. Therapy that consists of long-acting β2-agonists and inhaled corticosteroids is the first choice for the management of moderate persistent asthma. Nighttime symptoms of asthma may be controlled by the use of long-acting β2-agonists such as formoterol or salmeterol. Short-acting β2-agonists may be included for control of acute symptoms that may occur. Formoterol is effective in the prevention of exercise–induced asthma. The response to the use of formoterol and albuterol is similar at fifteen minutes after administration. However, prevention of bronchospasm endured for up to 12 hours compared to 0.25 hour with albuterol.

Formoterol is administered by oral inhalation using a special device that provides powdered drug from capsules. Formoterol fumerate is not intended for oral use. Formoterol fumerate capsules contain 12 mg of the drug. It has been estimated that the inhaler provides about 10 mcg of formoterol fumerate per activation. For maintenance therapy and prevention of daytime and nighttime asthma attacks, the usual dosage of orally inhaled formoterol fumerate is 12 mcg twice daily administered every 12 hours. Patients should not exceed this daily dosage. For the prevention of exercise-induced asthma, the dosage is 12 mcg administered 15 minutes prior to exercise. It is believed that due to its rapid action, advance administration of the drug is unnecessary. Patients who receive maintenance therapy of formoterol fumerate should not take additional dosage to prevent exercise induced asthma. Patients must be warned not to use the drug excessively because fatalities have been reported when the doses and frequency of administration are abused. Furthermore, formoterol may increase heart rate and blood pressure. Paradoxical bronchospasm has been reported immediately following the administration of the drug. In this case, the use of the drug must be discontinued. Formoterol is contraindicated in patients who experience hypersensitivity following administration. Side effects include tremor, stomach pain, musculoskeletal pain, urticaria, upper respiratory infections, nasopharyngitis and tachycardia.

Salmeterol xinafoate is a selective, long acting sympathomimetic amine. Chemically and pharmacologically it is identical to albuterol. It is used either alone or in combination with fluticasone propionate to prevent bronchospasm in patients with reversible obstructive airway, or for the prevention of exercise–induced asthma. The drug is not recommended for treating acute asthma attacks. Precautions, side effects and contraindications are similar to those of formoterol. Salmeterol xinafoate is administered by oral inhalation using a special inhaler that provides powdered drug alone or in fixed combination with fluticasone propionate from foil-wrapped blis-

ters. The canister releases 25 mcg of the drug once it is activated. However, only 21 mcg is delivered to the patient. For adults and children over 12 years of age, the dose is 42 mcg (2 inhalations) twice daily, given approximately every 12 hours.

Epinephrine is a β1-and β2-agonist. As such, it stimulates β1 receptors to cause an increase in cardiovascular activity. It also stimulates β2- receptors to relieve bronchospasm. Inhaled epinephrine is indicated for relief of asthma attacks. However, because of its effect on the cardiovascular system as well as the availability of selective β2-agonists, a decline in its use has resulted. The adverse effects of epinephrine include tachycardia, cardiac arrhythmia, tremor, hypertension and nervousness. Patients should be warned not to exceed the recommended dosage. Asthmatics should discontinue epinephrine if symptoms have not improved in 20 minutes, or if they become worse. It is contraindicated in coronary heart disease, heart failure, cardiac arrhythmia, hypertension, thyroid disease and diabetes. For relief of asthma attacks, a 1% epinephrine solution is administered through a pressurized, meter- dose dosage form. The solution is available as epinephrine, epinephrine hydrochloride and epinephrine bitartrate. A single inhalation from an epinephrine–containing inhaler provides the equivalent of 0.16 to 0.25mg of epinephrine base. Inhalation should not be repeated for at least 3 hours.

ANTICHOLINERGICS

Anticholinergics provide relief from bronchospasm by dilating the smooth muscles of the bronchial tree through competitive inhibition of muscarinic (M3) cholinergic receptors.

Ipratropium is a quaternary ammonium antimuscarinic agent that is used for the symptomatic relief of reversible asthma attacks and other chronic obstructive pulmonary disease, as well as in the prevention of exercise-induced asthma. When used alone, orally administered ipratropium has little effect on asthma; however, it potentiates the bronchodilatory effect of β2-adrenergic agonists. It is recommended to be used concurrently with orally inhaled corticosteroids for long term management of asthma. Ipratropium is intended for use as an adjunct to other therapy, and usually in combination with β2-adrenergic agonists. Its effect is slow, and as result it should not be used alone for managing acute asthma attacks. Ipratropium bromide is orally inhaled using an aerosol inhaler or nebulizer. A dose of 20 mcg per metered spray is recommended. Adverse effects of the drug are similar to those encountered following the use of antimuscarinic agents. It causes anticholinergic side effects such as blurred vision, dry mouth, and papillary dilation.

CORTICOSTEROIDS

Corticosteroids, such as beclomethasone, budesonide, flunisolide, fluticasone and triamcinolone are used via oral inhalation for the long-term prevention of bronchoconstriction caused by asthma. Corticosteroids block inflammation of the bronchial tree, reverse β-receptor down-regulation, inhibit leukotriene synthesis, and inhibit cytokine formation and adhesion protein activation. They possess delayed but not immediate reaction to allergens. Early intake of systemic corticosteroids may prevent aggravation and relapse of asthma attacks. Maintenance therapy with a low dose of inhaled corticosteroids is the treatment of choice for asthmatics with mild persistent asthma. In moderate persistent asthma a long-acting β2-adrenergic agonist is included along with a low to medium dose of corticosteroids. The main adverse effects include development of candida albicans in the mouth, pharynx and occasionally larynx, bronchus or esophagus, difficulty speaking, bronchospasm, cough, wheezing following inhalation, irritation of the mouth or throat and headache. Rinsing the mouth with water may reduce the risk of development of oral candidiasis.

MAST CELL STABILIZERS

Cromolyn is categorized as a mast cell stabilizer because it inhibits the release of histamine from these cells, thus it reduces airway hyperactivity and blocks early and delayed response to allergens. It is used in the aerosol and solution forms for oral inhalation as an adjunct to the treatment of asthma. Because of the nature of its mechanism of action, it is used to prevent asthma attacks from occurring, and has no effect in treating acute attacks. Response to treatment with cromolyn sodium takes place within the first 2-4 weeks of use. The drug is used to prevent exercise–induced bronchospasm as well as problems triggered by allergen, environmental pollutants and household mold and dust. Cromolyn is as effective as theophylline in the prevention of exer-

cise-induced bronchoconstriction, but not as effective as orally inhaled β2-adrenergic agonists. Some asthmatics may benefit more when cromolyn is administered along with an orally inhaled β2-adrenergic agonist and theophylline.

LEUKOTRIENE MODIFIERS

Leukotriene modifiers such as montelukast sodium, zafirlukast, and zilenton are leukotriene-receprtor antagonists that influence the inflammatory process occurring in asthma. Since the disease is believed to be triggered by endogenous inflammatory agents including leukotrienes, medications such as leukotriene modifiers, that block the action of leukotrienes at specific receptor sites on the airway smooth muscle, may prevent asthma attacks and provide long term symptomatic relief in patients with mild persistent to severe persistent asthma. They also have been used to prevent bronchospasm induced by exercise. Leukotriene modifiers are administered orally and should be taken at regular intervals. They do not provide immediate symptomatic relief, and thus should not be used for acute situations. Adverse effects include liver enzyme elevation, headache, dizziness, abdominal pain, nasal congestion, rash, myalgia, and cough.

METHYLXANTHINES

The methylxanthines used in the management of bronchospasm are: theophylline, aminophylline and dyphilline. Theophylline is structurally similar to caffeine and theobromine. It is found naturally in tea. It is only slightly soluble in water at pH 7, but its solubility increases with higher pH. Aminophylline is theophylline with ethylenediamine. Dyphylline is a distinct chemical entity, but has action and structure similar to theophylline. Theophylline and other methylxanthines act by relaxing the smooth muscles of the bronchial tree and are used in the symptomatic treatment of asthma or bronchospasm associated with chronic bronchitis and emphysema. They competitively inhibit the enzyme phosphodiesterase. In addition, the methylxanthines block intracellular release of Ca, decrease intravascular leakage into the bronchial mucosa, and prevent delayed reaction to allergens. They are used as an adjunct to β2–adrenergic agonists. Methylxanthine use is not very extensive at the present time due to their adverse reactions which include CNS stimulation, headache, GI irritation, nausea, vomiting, epigastric pain, anorexia, palpitation, tachycardia, urinary frequency, dehydration, elevated SGOT and seizures.

SUMMARY

Bronchial asthma is a common pulmonary disorder that affects people of all ages. The disease is characterized by dyspnea, wheezing due to bronchospasm. Factors that bring on sensitivity reactions as well as environmental factors play a role in causing asthma attacks. Asthma may be managed by environmental control and pharmacologic therapy.

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SUGGESTED TOPICS FOR 2008

Medication Errors Update	HIV/AIDS Update
New Standards on Cholesterol	New Standards on BP
OTC Antihistamines—-New Concerns for Pharmacy Practitioners	Which Cancers (If Any) Are We Gaining Control Of?
Review of New Drugs	BPH
Review of Popular Natural Supplements	

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LESSON EVALUATION

1. Does the program meet the learning objectives?

Discuss incidence of asthma in the U.S.	Yes	No
List symptoms of asthma	Yes	No
Relate significance of environmental control in management of asthma	Yes	No
Comment upon the major adverse effects of the beta 2 agonists	Yes	No
Discuss pharmacologic adjunct therapy used in management of asthma	Yes	No

2. Was the program independent & non-commercial Yes No

	Poor			Average		Excellent	
3. Relevance of topic	1	2	3	4	5	6	7

4. What did you like most about this lesson?_____

5. What did you like least about this lesson?_____

Please Select the Most Correct Answer

1. Which of these is false regarding asthma?
   A. Effects over 6% of people in U.S.
   B. Morbidity is higher among blacks than whites
   C. Annual medical cost nationwide estimated at $5 billion
   D. It causes about 5,000 deaths each year in the U.S.
2. Epinephrine is:
   A. Used only for the relief of bronchospasm
   B. A ß1 & ß2 agonist
   C. Used specifically for patients with coronary heart disease
   D. Used orally
3. Asthma characterized by daytime attacks more than twice a week, but not daily, is termed mild persistent.
   A. True B. False
4. A goal in treating asthma is to consider overexposure of triggering factors
   A. True
   B. False
5. What is true about albuterol
   A. Used for initial therapy for mild intermittent therapy
   B. A long-acting ß2-agonist
   C. Only used orally
   D. A ß1-agonist
6. Formoterol may reduce heart rate & blood pressure.
   A. True
   B. False
7. Exposure to allergens tends to cause:
   A. Degranulation of the mast cells
   B. Release of epinephrine
   C. Dilation of the bronchial tree
   D. Reduction in reactivity of airways
8. A side effect of ipratropium is:
   A. Running nose
   B. Diarrhea
   C. Blurred vision
   D. Papillary constriction
9. Which statement is correct regarding cromolyn?
   A. Relieves acute asthma attacks
   B. Should be taken internally
   C. More effective than ß2-agonists
   D. Inhibits release of histamine from mast cells
10. What statement is false concerning methylxanthines?
    A. Inhibit phosphodiesterase
    B. Block intracellular release of Ca
    C. Decrease intravascular leakage into bronchial mucosa
    D. Increase probability for delayed reaction to allergen

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