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Bronchodilators: Long-Acting Beta Agonists

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After completion the learner should be able to:

1. Identify appropriate indications for use of long-acting beta agonists (LABAs)
2. Relate general characteristics of LABAs to specific patient situations.
3. Apply nursing process considerations for LABAs to specific patient situations.

Chronic obstructive pulmonary disease (COPD) is a group of progressive lung diseases that include emphysema and chronic bronchitis. These chronic disorders result in damage to the alveolar tissue and bronchial structures with inflammation, increased mucous production, and bronchoconstriction. A key component of treatment for these disorders is bronchodilation, to reduce bronchospasm and improve air flow.

Sympathomimetic (also called adrenergic) agents are commonly used to promote bronchodilation. These are drugs that mimic the effects of the sympathetic nervous system, with responses such as increased heart rate and respirations, bronchodilation, dilation of the pupils, vasoconstriction, and tremors. These agents have long been used to treat bronchospasm associated with anaphylaxis or obstructive lung diseases, such as asthma and emphysema.

A problem with their use, however, is that there are four different types of adrenergic receptors that stimulate various sympathetic reactions—alpha$_1$, alpha$_2$, beta$_1$, and beta$_2$ receptors. The more of these receptors that are stimulated by a drug, the more (usually unwanted) effects occur. Epinephrine, for example, is a very effective bronchodilator. But, it stimulates both alpha and beta adrenergic receptors, and can cause a variety of other sympathetic effects, such as tachycardia and tremors.

When beta$_2$ receptors are stimulated, their primary action is relaxation of smooth muscle in the airway and uterus. Drugs that are selective for these receptors, the beta$_2$ receptor agonists, accomplish the goal of bronchodilation with fewer effects on other systems. These beta agonist drugs may be short-acting for immediate rescue use, such as albuterol, or they may be long-acting, for maintenance use.

This issue will focus on inhaled long-acting beta agonists (LABAs) for treatment of COPD. Available drugs in this class include:

- formoterol (Perforomist, Foradil)
- salmeterol (Serevent)
- arformoterol (Brovana)
- olodaterol (Striverdi Respimat)
- vilanterol (Anoro, Breo, Trelegy Ellipta)

In addition to LABAs, treatment of COPD typically includes use of inhaled corticosteroids to decrease inflammation, and anticholinergic agents to promote bronchodilation by a different action than LABAs. Because of this, LABAs are marketed in combination with corticosteroids such as fluticasone and budesonide, and anticholinergics such as tiotropium and umeclidinium.

Indications

LABAs are indicated to treat airflow obstruction and prevent bronchospasm in patients with COPD. They are indicated only for long-term prevention of bronchospasm, and should not be used for treatment of acute bronchospasm or rapidly worsening respiratory condition. Salmeterol and vilanterol are also approved to treat asthma, but only in combination with an inhaled corticosteroid.

Pharmacodynamics

Beta$_2$ receptor agents act by stimulating the beta$_2$ receptors in airway tissue, causing relaxation of bronchial smooth muscle. This results in relief of bronchospasm, increased diameter of airways, and decreased airway resistance.

Pharmacokinetics

Absorption: Acts directly on tissue in the airway, but enters systemic circulation through absorption by the pulmonary vessels and swallowing after oral inhalation.

Distribution: Moderate to high protein binding

Metabolism: Primarily in the liver

Elimination: Via renal and fecal routes

Major Interactions

Beta blockers, such as propranolol: May decrease the effectiveness of bronchodilators, possibly inducing bronchospasm; this effect may result from either systemic administration or eye drops.

Anti-diabetic agents: Beta agonist drugs may cause hyperglycemia, requiring increased amounts of insulin or oral hypoglycemic agents in diabetics.

Loop and thiazide diuretics: The risk of hypokalemia is increased with concurrent use of beta agonists.

MAOIs and tricyclic antidepressants: Concurrent use or use within two weeks may increase unwanted vascular effects, such as vasoconstriction and hypertension.

Drugs known to prolong the QT interval, such as amiodarone, macrolide antibiotics, citalopram and ondansetron: Concurrent use may cause cardiac dysrhythmias.

Adverse Effects/Toxicity

Common adverse effects include anxiety, nausea, insomnia, dizziness and headache. These usually subside with continued use. Hyperglycemia and hypokalemia are other known effects. Cardiac effects, such as sustained tachycardia, angina and dysrhythmias may occur, as well as life-threatening paradoxical bronchospasm. LABAs carry a boxed warning regarding the risk of death when used as monotherapy in patients with asthma. When indicated for use with asthma, they must be used with an inhaled corticosteroid.

Precautions/Contraindications

LABAs should be used cautiously in patients with cardiovascular disease, diabetes, and with conditions sensitive to sympathetic stimulation, such as seizure disorders or thyrotoxicosis.

Nursing Process

Assessment

Determine baseline status: A complete respiratory assessment should be performed prior to initiation of therapy. Baseline and periodic pulmonary function tests should be performed to determine disease progression. A thorough description of the patient's respiratory disease history should also be documented, focusing on precipitating events, duration of symptoms and frequency of acute attacks. In addition, obtaining a baseline cardiovascular assessment is necessary in the event adverse effects occur.

Identify risk factors: A complete list of all patient medications should be obtained to identify possible drug interactions. A thorough medical history should be obtained to identify conditions that require closer monitoring.

Age-specific considerations: As with any drug, risk/benefit must be considered for use in pregnant or breastfeeding women. Use of LABAs during labor and birth may affect uterine contractility. Geriatric patients may be more susceptible to the adverse effects of LABAs, and are more likely to have concurrent medical risk factors, such as cardiovascular disease.

Planning and Analysis

The goal of therapy with LABAs is to reduce the frequency and severity of episodes of bronchospasm.

Intervention

Medication administration: LABAs for treatment of COPD are available in inhalant form, either powder, aerosol, or a solution for use with a nebulizer. They are typically administered one to two times daily.

Observe for therapeutic effects: The patient's report of easier breathing, decreased shortness of breath, improved activity tolerance and decreased use of rescue inhaler is the best measure of therapeutic effect. With long-term maintenance use of LABAs, the frequency and severity of episodes of dyspnea and bronchospasm should reduce.

Observe for adverse effects: Assess for significant cardiovascular and respiratory effects, and report these to the physician. If sudden shortness of breath occurs, the LABA should be discontinued immediately, the prescriber notified, and a fast-acting rescue inhaler, such as albuterol, used to relieve symptoms. Also assess for headache, nausea, dizziness, tremors, insomnia, and anxiety.

Patient/Family teaching: Patient teaching should focus on safe administration of drug and monitoring of condition:

- Use inhaler or nebulizer according to instructions provided
- Take medication exactly as prescribed
- Do not rely on these drugs for relief of acute episodes of bronchospasm—a fast-acting inhaler is required
- Stop using the medication and contact the prescriber immediately for sudden worsening of respiratory symptoms
- Use sugar-free candy or ice chips for relief of dry mouth
- Keep a record of respiratory symptoms and use of rescue inhaler to assess effectiveness of treatment
- Avoid allergens, smoke, or other triggers that may cause bronchospasm

Evaluation

Through careful management, monitoring, and education, the nurse can assist patients who are taking inhaled LABAs to achieve maximum therapeutic benefit.

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Competency Assessment Tool

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NAME:_____ DATE: _____ UNIT:_____

Directions: Place the letter of the one best answer in the space provided.

_____1. Which of the following is NOT a common effect of sympathetic stimulation:
A. pupillary constriction
B. increased heart rate
C. vasoconstriction
D. tremors

_____2. In general, the more types of adrenergic receptors a drug stimulates, the more adverse effects occur.
A. True
B. False

_____3. $Beta_2$ receptor agonists act to improve oxygenation primarily by:
A. decreasing inflammation
B. relaxing bronchial smooth muscle
C. increasing alveolar tension
D. increasing the attachment of oxygen molecules to hemoglobin

_____4. Inhaled long-acting beta agonists (LABAs) are indicated for long-term maintenance prevention of bronchospasm and for rescue use with acute bronchospasm.
A. True
B. False

_____5. Which one of the following medications, taken concurrently with a LABA, is most likely to decrease the effectiveness of the LABA and cause possible bronchospasm:
A. digoxin, a cardiac glycoside
B. propranolol, a beta blocker
C. metformin, an oral hypoglycemic agent
D. furosemide, a loop diuretic

_____6. LABAs carry a boxed warning regarding the risk of:
A. fetal harm when used during pregnancy
B. QT prolongation
C. stroke due to severe hypertension and tachycardia
D. death when used alone for treatment of asthma

_____7. Which of the following is most likely to occur if LABAs are administered with drugs such as amiodarone and macrolide antibiotics:
A. hypokalemia
B. hyperglycemia
C. QT prolongation
D. seizures

_____8. Inhaled LABAs should be used cautiously in patients having:
A. diabetes
B. cardiovascular disease
C. seizure disorders
D. all of the above

_____9. Mrs. Parker is a patient with emphysema who has orders to take olodaterol spray, 2 inhalations once daily. After the first inhalation, Mrs. Parker becomes tachypneic and short of breath. The appropriate action of the nurse is to:
A. immediately administer the second inhalation
B. reassure Mrs. Parker that the medication will take effect soon
C. wait 10 minutes before administering the second inhalation
D. stop administration of the drug and notify the prescriber

_____10. Appropriate instructions for a patient taking an inhaled LABA include all of the following EXCEPT:
A. keep a record of your respiratory symptoms
B. use sugar-free candy or ice chips for dry mouth
C. take the drug promptly on noticing any COPD symptoms
D. avoid allergens, smoke and other triggers that may cause bronchospasm

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Group Tracking Log

Employee Name	Unit	Test Date	Score