

A COMPREHENSIVE REVIEW OF DEXAMETHAZONE

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ABSTRACT

Dexamethasone is a synthetic adrenal corticosteroid with strong anti-inflammatory characteristics. Dexamethasone binds to particular nuclear steroid receptors and inhibits NF- κ B activation and apoptotic pathways in addition to these other effects. The group of chemical substances known as 21-hydroxysteroids includes dexamethasone, sometimes referred to as dexone or decadron. These are steroids with a hydroxyl group attached to the steroid backbone at position 21. Dexamethasone is a substance that can exist as a solid and is thought to be essentially insoluble (in water) and basically neutral. Dexamethasone has been identified in human liver tissue, as well as numerous biofluids like blood and urine. Dexamethasone is mostly found in the cell membrane and cytoplasm. Dexamethasone takes involved in a variety of enzymatic processes. In particular, pregnane can be used to biosynthesize dexamethasone. It performs functions as an adrenergic agent, antiemetic, antineoplastic agent, xenobiotic, environmental pollutant, and anti-inflammatory medication.

Key Words: Dexamethasone, Xenobiotics, Apoptic Pathway, Adrenergic Agent, Antineoplastic.

INTRODUCTION

Dexamethasone, a type of corticosteroid, is a drug used to treat a number of ailments, including cancer, autoimmune illnesses, allergies, and asthma. It works by lowering bodily inflammation, which can aid in easing symptoms related to certain illnesses. There are numerous ways to get dexamethasone, including tablets, oral solution, injectable, and topical cream. The condition being treated and the particular patient will determine the precise dosage and length of the course of treatment. Cancer treatment is one of dexamethasone's most well-known applications. It can be used to treat or prevent cancer-related side effects like nausea and vomiting as well as the inflammation brought on by chemotherapy and radiation therapy. Dexamethasone is a medication that is frequently used for a number of different illnesses in addition to treating cancer. Asthma, allergies, and autoimmune conditions like lupus and rheumatoid arthritis are all frequently treated with it. Additionally, it can be used to treat skin diseases like dermatitis and eczema. Although dexamethasone is typically regarded as safe and efficient, it is crucial to adhere to the dosage and frequency recommendations given by a healthcare professional. Corticosteroids can have major adverse effects, such as an increased risk of infection, osteoporosis, and diabetes, when used excessively or for an extended period of time. As a result, dexamethasone is a popular corticosteroid drug that is successful in treating a wide range of illnesses, such as cancer, allergies, asthma, and autoimmune diseases. In order to reduce the danger of adverse effects, it is crucial to adhere to the dosage and frequency recommendations made by a healthcare professional.

PHYSICAL AND CHEMICAL PROPERTIES:

Appearance: White to off-white, crystalline powder

Solubility: Soluble in methanol, ethanol, and chloroform; slightly soluble in water

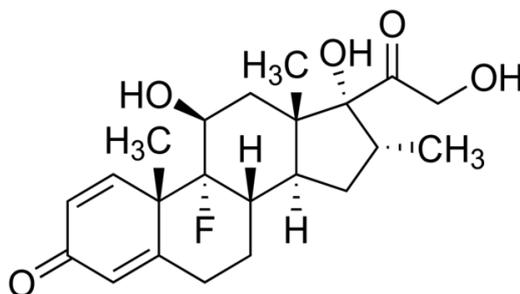
Molecular formula: C₂₂H₂₉FO₅

Molecular weight: 392.46 g/mol

CAS number: 50-02-2

Dexamethasone is a synthetic glucocorticoid receptor agonist, which means it activates the glucocorticoid receptor and can mimic the effects of the hormone cortisol. It has a high affinity for the glucocorticoid receptor and a long duration of action, making it more potent and longer-lasting than other corticosteroids. Dexamethasone is a prodrug, which means it is inactive until it is converted to its active form in the body. It is metabolized in the liver and excreted in the urine.

Structure of Dexamethasone :



IUPAC Name: (8*S*,9*R*,10*S*,11*S*,13*S*,14*S*,16*R*,17*R*)-9-fluoro-11,17-dihydroxy-17-(2-hydroxyacetyl)-10,13,16-trimethyl-6,7,8,11,12,14,15,16-octahydrocyclopenta[*a*]phenanthren-3-one

Mechanism of Action:

Corticosteroids penetrate cells and bind to a high affinity cytoplasmic receptor protein → a structural change occurs in the steroid receptor complex that allows its migration into the nucleus and binding to glucocorticoid response elements (GRE) on the chromatin → transcription of specific m-RNA → regulation of protein synthesis This process takes at least 30–60 min : effects of corticosteroid are not immediate, and once the appropriate proteins are synthesized—effects persist much longer than the steroid. In many tissues, the overall effect is catabolic, i.e. inhibition of protein synthesis. This may be a consequence of steroid directed synthesis of an inhibitory protein.

TYPES OF DOSAGE FORMS

Synthetic glucocorticoids like dexamethasone are used to treat a number of ailments such inflammation, allergies, and immune system problems. Tablets, oral solutions, injections, and inhalations are only a few of the dosage combinations and delivery methods that are offered. Dexamethasone may be used in conjunction with other drugs to treat disorders like:

- Severe asthma attacks: To treat severe asthma episodes, dexamethasone is frequently coupled with a bronchodilator drug.
- Bacterial meningitis can be treated with dexamethasone in addition to antibiotics.
- Cancer: Dexamethasone and chemotherapy drugs may be combined to treat cancer.
- Rheumatoid arthritis: Dexamethasone and nonsteroidal anti-inflammatory medications (NSAIDs) are both effective treatments for this condition.
- Multiple sclerosis: Dexamethasone can be used to treat multiple sclerosis in addition to other drugs.

Dexamethasone dosage and treatment time will vary depending on the ailment being treated, the patient, and other factors. When taking dexamethasone or any other drug, it's crucial to adhere to your doctor's instructions.

APPLICATIONS

Dexamethasone is a type of corticosteroid drug that is frequently prescribed to treat a variety of ailments. It can be used to suppress the immune system and is frequently used to alleviate allergies, edoema, and inflammatory reactions. Here are some illustrations of the numerous uses for dexamethasone:

1. Inflammation: Asthma, arthritis, and inflammatory bowel disease are just a few of the illnesses that dexamethasone is frequently used to treat. It functions by preventing the body from producing specific molecules that lead to inflammation.
2. Allergic responses to bug bites and stings: Dexamethasone is also used to treat allergic reactions to insect bites and stings, including hay fever. Sneezing, itching, and swelling problems can all be lessened with its assistance. Dexamethasone is frequently used to treat allergies, including:
 - Allergic rhinitis (hay fever): Dexamethasone can be used to treat the hay fever nasal symptoms such congestion, sneezing, and runny nose.
 - Allergic asthma: Dexamethasone can be used to treat allergic asthma's respiratory symptoms, including coughing, wheezing, and breathing difficulties.
 - Skin allergies: Dexamethasone can be used to treat allergic skin problems such hives, eczema, and dermatitis. The afflicted area can receive topically administered treatment in the form of a cream, ointment, or lotion.
3. Autoimmune conditions: In patients with autoimmune conditions including lupus and multiple sclerosis, dexamethasone can be used to suppress the immune system. This may lessen the intensity of the symptoms and enhance general quality of life.
4. Cancer: Dexamethasone is occasionally used to treat certain cancers, including leukaemia and lymphoma. Chemotherapy adverse effects may be lessened, and treatment efficiency may be increased.
5. Adrenal insufficiency, a disorder where the adrenal glands don't produce enough hormones, can be treated with dexamethasone. It can assist in restoring the missing hormones and easing symptoms including weakness, exhaustion, and low blood pressure.

Dexamethasone is a flexible drug that can be used to treat a variety of illnesses. The suppression of the immune system and reduction of inflammation are two of its most notable uses, but it also has a variety of other crucial uses.

It is an effective anti-inflammatory drug that may aid in reducing swelling and inflammation in the airways, which may make breathing easier. Although it is typically administered through inhalation using an inhaler or nebulizer

Dexamethasone is frequently combined with other drugs, such as bronchodilators, to treat asthma in order to assist manage symptoms and enhance lung function. Since it can have negative effects when used long-term, it is typically saved for more severe instances of asthma.

An overreacting immune system to a substance that is typically innocuous to most individuals results in allergies. Your body's immune system reacts to an allergy trigger by mistaking it for a dangerous substance and releasing histamine and other substances that exacerbate allergy symptoms.

Because dexamethasone suppresses the immune system and lowers the synthesis of these substances, it can be beneficial in treating allergies. It is often ingested orally as a tablet or liquid, although it can also be administered intravenously or topically.

It is crucial to remember that dexamethasone is a powerful drug and should only be used under a doctor's care. It shouldn't be used as a long-term treatment for allergies because it can have dangerous adverse effects if taken in high dosages or for an extended period of time. Based on your unique condition and needs, your doctor will choose the right dosage and length of treatment for you.

RISKS

Dexamethasone can lead to negative effects, much like all drugs. Dexamethasone's potential negative effects could include the following:

- gastrointestinal irritation, such as heartburn, ulcers, and tummy aches
- fluid retention, which can result in hand, foot, or ankle swelling
- alterations in mood, such as agitation and depression
- alterations in appetite that may result in weight gain or loss

- variations in blood sugar levels, which may need monitoring in diabetics;
- changes in blood pressure;
- problems sleeping (insomnia);
- higher risk of infection;
- increased risk of developing osteoporosis (weak bones);

UV

In ultraviolet (UV) spectroscopy, the absorbance of a material is assessed at various UV light wavelengths. It is possible to determine a substance's presence and concentration using the resulting UV-Vis spectrum. Numerous academic studies have researched and reported on the UV-Vis spectrum of dexamethasone. A study indicated that dexamethasone has considerable absorbance in the UV-Vis region of 200-400 nm, with a maximal absorbance at 246 nm. This study was published in the *Journal of Pharmaceutical and Biomedical Analysis*. A different study discovered that the UV-Vis spectra of dexamethasone displays a broad absorption band in the range of 200-400 nm, with a maximum absorbance at 246 nm and a shoulder at 300 nm. This work was published in the journal *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy*. Overall, dexamethasone's UV-Vis spectrum can be utilised to detect and measure the drug's presence in a variety of materials, including pharmaceutical formulations and biological fluids.

HPLC

Compounds in a mixture can be separated, identified, and quantified using high-performance liquid chromatography (HPLC). Dexamethasone, a corticosteroid drug used to treat a number of illnesses like allergies, inflammation, and immune system disorders, is one of the many substances that it may be used to examine. A sample containing the substance is injected into the chromatography system, which is made up of a pump, a column filled with a stationary phase, and a detector, to perform HPLC analysis of dexamethasone. The dexamethasone is isolated from the sample based on how it interacts with the stationary phase in the column after being delivered through it by the pump. The detector, which calculates the concentration of each chemical in the sample, is next passed through by the separated compounds. The selection of the stationary phase, the pH of the mobile phase, the flow rate, and the system temperature are just a few of the variables that might have an impact on the precision and dependability of HPLC analysis. To guarantee the greatest outcomes, it is crucial to properly optimise these circumstances. In pharmaceutical and biological research, as well as in quality assurance and manufacturing, HPLC is a commonly utilised technology. It is a crucial instrument in the creation and manufacturing of medicines and other compounds because it enables the quick and accurate analysis of a variety of substances, including dexamethasone.

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