The Effect of Dexamethasone on Covid-19

Katie Smith
Faculty Mentor: Dr. Cubon, Department of Chemistry, Kent State University Trumbull Campus, Warren, OH

Abstract

Dexamethasone is a corticosteroid whose anti-inflammatory properties have been found to yield positive effects in treating covid-19. Coronavirus is a respiratory illness that attacks the epithelial cells of the lung, thus blocking airways and leaving them subject to debris and fluids. Dexamethasone is a synthetic glucocorticoid that may help with inflammation in the lung as a result of Covid-19. During a clinical trial done by Oxford University called the RECOVERY trial, the use of dexamethasone resulted in lower 28-day mortality rates than those receiving traditional care with oxygen or mechanical ventilation. 

Background & History

Covid-19 targets the lungs and rapidly invades cells in the respiratory system. The lungs become inflamed as the body tries to fight and dexamethasone helps to calm the inflammation. 

Chemical Components

Its reactive groups consist of: 
- alcohols, polyols, ketones and aliphatic unsaturated hydrocarbons.
- The addition of the Fluorine atom makes dexamethasone more potent than other glucocorticoids.
- Methyl group on cyclopentane provides for a longer period of action and duration.

Figure 3. Chemical structure of dexamethasone

Glucocorticoids are a type of corticosteroid and are typically synthetic compounds with anti-inflammatory effects. When the body is fighting a foreign substance such as covid-19, it can have the tendency to produce an overly intense immune response that is harmful and glucocorticoids help inhibit that. The 3-C like proteinase on SARS-CoV-2 inhibits histone deacetylase from going to the nucleus which in turn can be life threatening as the immune system is overstimulated. Histone deacetylase is activated on dexamethasone, it opposes the action of SARS-CoV-2.

Figure 3. Chemical structure of dexamethasone

Figure 4. Cytokines are small proteins that play a role in directing the body’s immune response.

Effects on the Body

Dexamethasone suppresses inflammation triggered by Coronavirus and calms down the immune system response in the lungs. However, dexamethasone only works on severely ill patients because if a patient is showing mild symptoms, suppressing the immune system does more harm than good. Glucocorticoid receptors move into the cell nucleus and the response created is associated with genes that suppress and inhibit proinflammatory mediators that help with inflammation.

Figure 5. Dexamethasone shown in tablet form, the most used form in treating covid-19 patients.

Health Effects

Using a corticosteroid like dexamethasone inhibits your body’s ability to respond to stress well. With long-term use, dexamethasone can lead to a need for increased dosage due to physical stress. Additionally, due to dexamethasone’s anti-inflammatory properties, it may also suppress the body’s ability to fight infection. Increased risk of gastrointestinal problems are possible which may lead to ulcers and GI bleeding.

Other health effects include: 
- Osteoporosis
- Weight gain
- Insomnia
- Mood changes
- Fluid retention
- Elevated blood pressure/sugar
- Glaucoma
- Atherosclerosis

Addition & Withdrawal

Rapid withdrawal can occur in some cases causing: 
- fatigue, joint pain, muscle stiffness, muscle tenderness or fever.
- If used for less than two weeks, rapid withdrawal is less likely to happen which is the case when using dexamethasone for covid-19 treatment.
- Since dexamethasone is a steroid medication, addition and withdrawal symptoms depend on dosage and how long it is taken. If using to treat covid-19, the addition and withdrawal symptoms are minimal if not none.

Important Statistics

Dexamethasone is found to reduce deaths by one-third in patients receiving mechanical ventilation and by one-fifth in patients receiving oxygen. In 2020, covid-19 patients were randomized to receive treatment with dexamethasone and results showed dexamethasone reduced deaths in ventilated patients and those receiving oxygen. This was part of the RECOVERY trial to identify treatments that may be useful in treating covid-19.

Conclusion

Dexamethasone is a low-cost corticosteroid with properties that can aid in Covid-19 treatment among patients. Its treatment has been found to reduce deaths in severely ill patients when compared to treatment using oxygen or ventilation methods alone. The glucocorticoid dexamethasone reduces inflammation in the lungs due to Coronavirus and relaxes the immune system response. The negative health effects are minimal when used in small amounts over a short time span which is the case when used to treat Coronavirus. Dexamethasone has been tested in clinical trials and proved a safe and positive treatment for patients with severe Covid-19.

References