NEW COMBINATION OF ANTIASTHMA MEDICAMENTS

Field of the Invention

The present invention relates to compositions and methods useful in the treatment of respiratory disorders, particularly asthma.

Background of the Invention

Despite recent advances in the awareness of asthma and the introduction of powerful and effective anti-asthma drugs, asthma remains a poorly understood and frequently poorly treated disease. There have been recent advances in the treatment of the disease which result from the recognition that asthma is a chronic inflammatory disease. Therapy is now aimed at both controlling the symptoms and reducing the inflammation. The symptoms include uncontrolled airway inflammation which may lead to mucosal damage and structural changes possibly leading to irreversible narrowing of the airways and fibrosis of the lungs.

The symptoms may be controlled by β_2-adrenoreceptor agonists such as salbutamol, bambuterol, clenbuterol, fenoterol, procaterol, bitolterol, broxaterol, salmeterol, terbutaline and formoterol.

Prophylactic therapy is typically provided by steroids such as beclomethasone dipropionate (BDP), beclomethasone monopropionate (BMP), flunisolide, triamcinolone acetonide, dexamethasone, tipredane, ciclesonid, momethasone, RPR 106541, fluticasone or fluticasone propionate and budesonide or by way of sodium cromoglycate or nedocromil sodium.

Summary of the Invention

The invention is based on the discovery that formeterol and rofleponide esters, or their salts or solvates, when administered to a patient either concurrently or sequentially, are unexpectedly effective in treating respiratory disorders involving inflammation, such as asthma. Accordingly, the invention features a composition having, in an admixture: (a) a first active ingredient which is formoterol, a pharmaceutically acceptable salt or solvate of formoterol, or a solvate of such a salt; and (b) a second active ingredient which is rofleponide or a fatty acid ester of rofleponide.

It is preferred that the molar ratio of (a) to (b) is from 1:1 to 1:100, preferably from 1:1 to 1:60, more preferably from 1:1 to 1:35, and most preferably from 1:16.

The first active ingredient (a) of the composition can be, for example, formoterol fumarate dihydrate, and the second active ingredient (b) of the composition can be, for example, rofleponide palmitate.

The composition can be provided in the form of a dry powder, the particles of which may have a mass median diameter of less than 10μm.

The invention also includes a kit containing: (a) a vessel containing a first active ingredient that is formoterol, a pharmaceutically acceptable salt or solvate thereof, or a solvate of such a salt; (b) a vessel containing a second active ingredient that is either rofleponide or a fatty acid ester of rofleponide; and (c) instructions for the sequential or simultaneous administration of the first and second active ingredients to a patient in need thereof.

A patient suffering from a respiratory disorder such as asthma can be treated by administering (e.g., via inhalation), simultaneously or sequentially, (a) a dose of a first active ingredient selected from the group consisting of formoterol, a pharmaceutically acceptable salt or solvate thereof, and a solvate of such a salt; and (b) a dose of a second active ingredient selected from the group consisting of rofleponide and a fatty acid ester of rofleponide. The active ingredients can be provided to the patient for inhalation in dry powder form.

When administered sequentially, the active ingredients can be administered in either order, and within a two-hour time period. For example, the first active ingredient can be

administered to the patient less than about 30 minutes after the second active ingredient, or the second active ingredient can be administered to the patient less than about 30 minutes after the first active ingredient.

Other features and advantages of the invention will be apparent from the following description of the preferred embodiments thereof, and from the claims.

The combination according to the invention has the advantage that the toal dose of each active ingredient can be decreased and is more likely to provide patient compliance then would be extected from the properties of the individual active ingredients.

Detailed Description

The invention provides a composition having (a) a first active ingredient selected from the group consisting of formoterol, a pharmaceutically acceptable salt or solvate of formoterol, and a solvate of such a salt; (b) a second active ingredient selected from the group consisting of rofleponide and a fatty acid ester of rofleponide; and, optionally, (c) one or more pharmaceutically acceptable additives, diluents or carriers.

It has been found, using a sephadex-induced edema model (Källström et al., Agents and Action 17:355-377 (1985)), that the combination of active ingredients provides a significantly enhanced anti-inflammatory effect compared to the sum of the individual anti-inflammatory effects of the two active ingredients, thus providing a significant advantage.

The first and second active ingredients of the composition can be administered simultaneously or sequentially to treat respiratory disorders. By simultaneous is meant that the first and second active ingredients (a) and (b) are administered concomitantly, for example as an admixture. Sequential administration generally comprises administering one immediately after the other. They still have the desired effect if they are administered separately but not more than about two hours apart, for example no more than 30 minutes and preferably no more than 5 minutes apart.

Preferably the composition is administered to provide a daily dose of from 0.5 to 200 nmol (preferably from 4 to 100 nmol) of (a) and from 0.5 to 1140 nmol (preferably 14 to 285 nmol and more preferably from 14 to 285 nmol) of (b) (subject to the molar ratio of (a) to (b) being from 1:1 to 1:100).

When (a) is formoterol fumarate dihydrate, the preferred daily dose is from 0.2 to 84 μg (preferably from 2 to 42 μg) of (a), and from 0.4 to 800 μg (preferably from 10 to 400 μg, more preferably from 10 to 200 μg) of (b) where (b) is rofleponide palmitate (subject to the molar ratio of (a) to (b) being within the range of from 1:1 to 1:100).

Suitable physiologically acceptable salts of formoterol include acid addition salts derived from inorganic and organic acids, for example the chloride, bromide, sulphate, phosphate, maleate, fumarate, tartrate, citrate, benzoate, 4-methoxybenzoate, 2- or 4-hydroxybenzoate, 4-chlorobenzoate, p-toluenesulphonate, methanesulphonate, ascorbate, acetate, succinate, lactate, glutarate, gluconate, tricarballylate, hydroxynaphthalene-carboxylate or oleate salts or solvates thereof. Active ingredient (a) is preferably formoterol fumarate, especially as the dihydrate.

Rofleponide is preferably esterified by a palmitoyl group.

Preferably each of the active ingredients comprises one or more pharmaceutically acceptable additives, diluents or carriers, more preferably in an amount of from 50 to 2000 μg in a daily dose, most preferably in an amount of from 100 to 1000 μg. Examples of suitable diluents or carriers include lactose, dextran, mannitol and glucose. Preferably lactose is used.

Since active ingredient (b) is preferably a fatty acid ester, formulations containing it are desirably liposomal or proliposomal if they are dry powder formulations. Suitable proliposomal formulations of fatty acid esters of rofleponide are described in WO 96/19199. For improved stability the formulation may comprise tocopherol, especially α-tocopherol.

Active ingredients (a) and (b) may optionally be formulated together to be administered simultaneously. For example, they may be formulated in admixture as a proliposomal powder, for example of the general type described in WO 96/19199 (preferably containing tocopherol as a stabilizing agent) or as an intimate mixture of (a) in the form of a dry powder and a proliposomal dry powder containing (b).

One or more of the active ingredients according to the invention are preferably in the form of a dry powder, more preferably a micronised dry powder, e.g. having a mass median diameter of less than 10μm, for example from 1 to 5μm, most preferably an

agglomerated micronised dry powder. Alternatively active ingredient (a) may be in the form of an ordered mixture with ingredient (c). The ingredients used in the invention can be obtained in these preferred forms using methods known to those of skill in the art.

The invention further provides a method of treating a respiratory disorder, which is preferably asthma, chronic obstructive pulmonary disease (COPD) and/or rhinitis, which method comprises applying to a patient suffering from, or liable to suffer from, such a disorder a therapeutically effective amount of a combination according to the invention.

According to the invention there is further provided the use of an admixture or kit according to the invention in the manufacture of a medicament for simultaneous, separate or sequential use in therapy, preferably in the treatment of a respiratory disorder, e.g. asthma, chronic obstructive pulmonary disease (COPD) and/or rhinitis.

Administration may be by inhalation orally or intranasally. The ingredients are preferably adapted to be administered from a dry powder inhaler.

The combination may optionally be administered as divided doses from 1 to 4, and preferably once or twice a day, which means unit doses from 0.05 μg to 84 μg (preferably from 0.5 μg to 42 μg) of formoterol fumarate dihydrate and from 0.1 μg to 800 μg (preferably from 2.5 μg to 400 μg) of rofleponide palmitate.

Example 1

Rofleponide palmitate (10 parts by weight), dipalmitoylphosphatidylcholine (63 parts), dimyristoylphosphatidylcholine (24 parts), sodium dipalmitoylphosphatidylglycerol (3 parts) and racemic α-tocopherol (0.1 part) were dissolved in tertiary butanol (1300 parts) at 80°C. The solution was poured onto the shelves of a freeze-dryer cooled to -35°C. The solution had reached this temperature after about 30 minutes, the pressure in the freeze-dryer was then reduced in order to induce sublimation of the solvent. While the rate of sublimation could be adjusted by decreasing the pressure and increasing the temperature, the temperature throughtout the process was not allowed to exceed -10°C. Freeze-drying was continued until all the solvent had been removed. The resulting powder was scraped from the shelves of the freeze-dryer and passed through a sieve. This powder was micronised in an air jet mill to a powder particle size of less than 5 μm.

0.5 parts of formoterol fumarate dihydrate was mixed with 79.5 parts of lactose monohydrate. The blend was micronised using a high pressure air jet mill and then conditioned using the process of EP-A-717 616. This mixture (80 parts) was added to the steroid/lipid powder mixture (20 parts) by mixing and homogenising with a low pressure jet mill. The mixture was then spheronised using the process of EP-A-721 331 and filled into a blister, a capsule or a storage chamber of an inhaler for use in a dry powder inhaler.

Other Embodiments

It is to be understood that while the invention has been described in conjunction with the detailed description thereof, the foregoing description is intended to illustrate and not limit the scope of the invention, which is defined by the scope of the appended claims. Other aspects, advantages, and modifications are within the scope of the following claims.

What is claimed is:

1. A therapeutic composition comprising, in admixture:

(a) a first active ingredient selected from the group consisting of formoterol, a pharmaceutically acceptable salt or solvate thereof, and a solvate of such a salt; and

(b) a second active ingredient selected from the group consisting of rofleponide and a fatty acid ester of rofleponide.

2. The composition of claim 1, wherein the molar ratio of (a) to (b) in the composition is from 1:1 to 1:100.

3. The composition of claim 1 or 2, wherein (a) is formoterol fumarate dihydrate.

4. The composition of any one of claims 1 to 3, wherein (b) is rofleponide palmitate.

5. The composition of any one of claims 1 to 4, additionally comprising a pharmaceutically acceptable additive, diluent or carrier suitable for inhalation.

6. The composition of any one of claims 1 to 5, in the form of a dry powder the particles of which have a mass median diameter of less than 10μm.

7. A kit comprising

(a) a vessel containing a first active ingredient selected from the group consisting of formoterol, a pharmaceutically acceptable salt or solvate thereof, and a solvate of such a salt;

(b) a vessel containing a second active ingredient selected from the group consisting of rofleponide and a fatty acid ester of rofleponide; and

(c) instructions for the sequential or simultaneous administration of the first and second active ingredients to a patient in need thereof.

8. The kit of claim 7, wherein the first active ingredient is formoterol fumarate dihydrate.

9. The kit of claim 7 or 8, wherein the second active ingredient is rofleponide palmitate.

10. The kit of any one of claims 7 to 9, wherein the instructions specify that the first and second active ingredients be administered in a molar ratio ranging from 1:1 to 1:100.

11. A method of treating a respiratory disorder, which method comprises simultaneously or sequentially administering to a patient suffering from the disorder

(a) a dose of a first active ingredient selected from the group consisting of formoterol, a pharmaceutically acceptable salt or solvate thereof, and a solvate of such a salt; and

(b) a dose of a second active ingredient selected from the group consisting of rofleponide and a fatty acid ester of rofleponide.

12. The method of claim 11, wherein the molar ratio of (a) to (b) is from 1:1 to 1:100.

13. The method of claim 11 or 12, wherein the first active ingredient is formoterol fumarate dihydrate.

14. The method of any one of claims 11 to 13, wherein the second active ingredient is rofleponide palmitate.

15. The method of any one of claims 11 to 14, wherein the first active ingredient is administered to the patient less than about 30 minutes before and after the second active ingredient.

16. The method of any one of claims 11 to 15, wherein the doses are administered to the patient by causing the patient to inhale them simultaneously.

17. The method of claim 16, wherein the first and second active ingredients are both provided to the patient for inhalation in dry powder form.