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(54) Title: HEARTBURN TREATMENT

(57) Abstract: The present invention is directed to the use of an alkali metal salt of a bicarbonate, preferably sodium bicarbonate, and an effective amount of a proton pump inhibitor in combination for the treatment of heartburn symptoms.

HEARTBURN TREATMENT

FIELD OF THE INVENTION

This invention discloses use of an omeprazole-bicarbonate combination for the treatment of heartburn, and acid indigestion.

BACKGROUND OF THE INVENTION

US patent, 5,840,737, Phillips, J. issued Nov 24 1998, describes a combination of a bicarbonate salt and omeprazole. The claims are directed to treatment of gastric acid disorders (unspecified) with a single dose of a pharmaceutical composition of omeprazole or lansoprazole together with a bicarbonate salt (Na or K preferred). The dose is orally administered as an aqueous solution or suspension.

The Philips patent focuses on the prophylactic prevention of upper GI bleeding in critically ill patients. It is particularly directed toward stress ulcer prophylaxis which has become routine therapy in intensive care units in most hospitals. An inherent advantage is the ability to infuse the solution via a nasogastric tube directly into the stomach. Data indicates that the omeprazole-bicarbonate solution/suspension combine the rapid onset of pH neutralization (due to bicarbonate) with the prolonged duration of effect of the proton pump inhibitor (PPI). There is an enhancement in time to onset of action of the PPI, omeprazole. This is postulated to reflect an effect of the bicarbonate to enhance the absorption of omeprazole. Indeed, in the presence of the bicarbonate omeprazole is observed to more rapidly become available systemically, and initial absorption of omeprazole is observed within 10-12 minutes in the combination as compared to 2-3 hours for omeprazole administered as enteric coated pellets.

However, Phillips does not suggest that the administration of a PPI plus a bicarbonate would be useful as a means to provide rapid onset, and prolonged duration of effect for relief of heartburn symptoms, nor in avoiding the reocurrence of heartburn symptoms.

Omeprazole has been formulated in many different embodiments such as in a mixture of polyethylene glycols as shown in U.S. Pat. No. 5,219,870 to Kim; U.S.

Pat No. 5,395,323 to Berglund discloses a device for mixing a pharmaceutical from a solid supply into a parenterally acceptable liquid form for parenteral administration to a patient.

U.S. Pat. No. 4,786,505 to Lovgren et al., discloses a pharmaceutical preparation containing omeprazole together with an alkaline reacting compound or an alkaline salt of omeprazole optionally together with an alkaline compound as a core material in a tablet formulation. The use of the alkaline material, which can be chosen from such substances as the sodium salt of carbonic acid, are used to form a "micro-pH" around each omeprazole particle to protect the omeprazole which is highly sensitive to acid pH.

The ability to provide a patient with a single dose administration of a preparation which has a rapid onset of acid neutralization would be a highly desirable dosage form for the treatment or prevention of heartburn symptoms.

SUMMARY OF THE INVENTION

The present invention is directed to a method of treating and/or preventing heartburn symptoms in a human in need thereof, which method comprises administering to said human a pharmaceutical composition comprising an effective amount of a proton pump inhibitor and an effective acid neutralizing amount of an alkali metal bicarbonate salt.

The administration preferably consists of a single dosage without requiring further administration of a second dose of a bicarbonate salt.

DETAILED DESCRIPTION OF THE INVENTION

The present invention is directed to single dose administration of a pharmaceutical composition for relief of heartburn symptoms. The term "heartburn symptoms" as used herein includes heartburn related to indigestion, sour stomach, upset stomach, episodic and co-incidental heartburn with meals, and heartburn related to gastroesophageal reflux of acid stomach contents. These are generally well recognized symptoms which are typically treated with, over-the-counter (OTC) medications, such as antacids, and more recently histamine H_2 receptor antagonists at reduced dosage. The treatments considered herein are the same as those symptoms for which various regulatory agencies, such as the FDA, have approved the use of H_2 receptor antagonists without prescription.

The present invention's use in the treatment of heartburn is a treatment which is safe, effective and useful for self-limiting gastrointestinal conditions. This

treatment is in contrast to the use of a proton pump inhibitor and an alkali metal bicarbonate salt for medically diagnosable gastrointestinal diseases, such as active duodenal ulcers, gastric ulcers, gastroesophageal reflux disease (GERD), severe erosive esophagitis, poorly responsive systematic GERD, and pathological hypersecretory conditions such as Zollinger Ellison syndrome. The dosage administration is basically a once only treatment, and is not necessarily used for multiple daily dosing over a period of many days, weeks or long term duration, although it is recognized that it could be used as such.

Suitable proton pump inhibitors (PPI) useful in the present invention include those antisecretory compounds belonging to the class of compounds generally referred to as substituted benzimidazoles. Omeprazole is a substituted benzimidazole, 5-methoxy-2-[(4-methoxy-3,5-dimethyl-2-pyridinyl) methyl] sulfinyl]-1H-benzimidazole. Also suitable for use herein are the individual enantiomers, of omeprazole, such as the (S) isomer, or a suitable salt form, such as the calcium or magnesium salts, or a combination of both such as the (S) magnesium salt of omeprazole. Other substituted benzimidazoles suitable for use herein include, but are not limited to lansoprazole, 2-[[[3-Methyl-4-(2,2,2-trifluoroethoxy)-2-pyridinyl]methyl]sulfinyl]-1H-benzimidazole; pantoprazole, 5-(Difluoromethoxy)-2-[[(3,4-dimethoxy-2-pyridinyl)methyl]sulfinyl]-1H-benzimidazole, and rabeprazole 2[[[4-(3-methoxypropoxy)-3-methyl-2-pyridinyl] methyl]sulfinyl]-1H-benzimidazole.

This class of compounds (the proton pump inhibitors) inhibit gastric acid secretion and do not exhibit anti-cholinergic or histamine H_2 antagonist properties. Drugs of this class suppress gastric acid secretion by the specific inhibition of the H< + > /K< + > ATPase enzyme system at the secretory surface of the gastric parietal cell.

Current use of proton pump inhibitors, particularly intravenous or oral liquid dosage forms is primarily directed towards medically diagnosable treatment of ulcers, or other medical determined mucosal bleeding of the gastrointestinal tract. Combinations of various H_2-antagonists, antacids and sucralfate are other currently used treatment options as prophylaxis for such damage.

These uses are however, not directed to the prevention or the treatment of heartburn symptoms.

Several buffered omeprazole solutions have been disclosed in publications, Andersson et al., Clinical Pharmacokinetics 24(1):71-8 (1993); Landahl et al. Clinical Pharmacokinetics 23 (6); 469-76 (1992); Andersson et al., Br. J. Clin. Pharmacol., 29(5):557-63 (1990); Regardh et al., Ther. Drug Monit. 12(2):163-72 (1990);

Andersson et al., Eur. J. Clin. Pharmacol., 39(2):195-7 (1990); and Pilbrant et al., Gastroenterol Suppl., 108:113-20 (1985).

All of the buffered omeprazole solutions described in these publications were administered orally and were given to healthy subjects who were able to ingest the oral dose. In all of these studies, omeprazole was suspended in a solution including sodium bicarbonate, as a pH buffer, in order to protect the acid sensitive omeprazole during administration. In all of these studies, the repeated administration of sodium bicarbonate both prior to, during, and following omeprazole administration were required in order to prevent acid degradation of the omeprazole given via the oral route of administration.

The bicarbonate was not given for its acid neutralizing capacity as an antacid, but for its use in preventing the degradation of the PPI. As a result, the ingestion of the large amounts of sodium bicarbonate and large volumes of water were required in contrast to the present invention. In these above-cited studies, as much as 48 millimoles of sodium bicarbonate in 300 ml of water were ingested in association with a a single dose of omeprazole for oral administration.

The present invention does not require the ingestion of excessive volumes of bicarbonate with water. Furthermore, the enhancement in onset of the PPI's action allows use of a minimal dose to achieve rapid and long-lasting relief of heartburn symptoms. The use of the combination of the PPI and bicarbonate permits using the PPI at dosages which are often suboptimal for standard Rx therapeutic applications (e.g., healing of duodenal or gastric ulcers, healing esophageal erosions, etc.). In the case of omeprazole, a dosage of about 10 to about 20 mg is desired.

Another aspect of the present invention is a dosage form of the omeprazole and bicarbonate which can be utilized to quickly make an omeprazole solution/suspension which is supplied in a solid form, such as in a powder form of a sachet, or as readily dispersible tablet or capsule. Alternatively the solid dosage form of omeprazole and bicarbonate, such as in a compressed tablet or capsule for oral ingestion may also be suitable, or even desired for use by the patient for the treatment of their heartburn symptoms.

An advantage of either the solution/suspension formulation or the solid dosage formulation are that both provide a means for the rapid onset and prolonged duration of effect for relief of heartburn symptoms and avoid the recurrence of these heartburn symptoms.

The pharmaceutical composition of the present invention may be prepared in accordance with Phillips, J., US Patent No. 5,840,737 whose disclosure is incorporated

herein by reference in its entirety. The composition may also be prepared by mixing omeprazole or other substituted benzimidazoles and derivatives thereof, with a solution including a bicarbonate salt of a Group IA metal. Preferably, omeprazole powder or granules, which may be enteric coated or not, are mixed with a sodium bicarbonate solution to achieve a desired final omeprazole concentration. The concentration of omeprazole in the solution/suspension can range from approximately 0.25 mg/ml to approximately 6.0 mg/ml. The preferred concentration for the omeprazole in the solution/suspension ranges from approximately 0.5 mg/ml to approximately 2 mg/ml.

The pharmaceutically acceptable alkali metal salt of a bicarbonate is preferably a Group IA metal salt, such as potassium or sodium. The concentration of the bicarbonate salt in the composition generally ranges from approximately 5.0 percent to approximately 60.0 percent. Preferably, the concentration of the bicarbonate salt ranges from approximately 7.5 percent to approximately 10.0 percent. In one embodiment of the present invention, sodium bicarbonate is the preferred salt and is present in a concentration of approximately 8.4 percent. A sufficient acid neutralizing capacity (ANC) amount is necessary and that will range from about 5 to about 40 ANC values, preferably from about 18 to 40 ANC values. It should be noted that the FDA considers an ANC value of 5 to be the minimum amount useful as an antacid. In the case of sodium or potassium bicarbonate preferred range is 18 to 40mEq, for calcium bicarbonate it is from about 36 to 80 mEq.

The amount of sodium bicarbonate used in the solution/suspension of the present invention is approximately 1 meq (or mmole) sodium bicarbonate per 1-2 mg omeprazole, with a range of approximately 0.75 meq (mmole) to 2.0 meq (mmole) per 1-2 mg of omeprazole, preferably 0.5 to 1.5mEq/1-2 mg of omeprazole.

In an another aspect of the present invention, enterically-coated omeprazole granules may be used and admixed with the sodium or potassium bicarbonate ($NaHCO_3$) solution which dissolves the enteric coating and forms an omeprazole solution/suspension for use in accordance with the present invention. Alternatively a solid dosage formulation of the enteric coated granules with the bicarbonate may be made and placed into capsules, or using the many techniques now known in the art, formulated into a compressed tablet.

Alternatively, micronized granules of a PPI, such as omeprazole may be used in place of conventional granules or powder. The process known as micronization is utilized in order to produce a particle having a smaller diameter. Micronization is the process by which solid drug particles are reduced in size. Since the dissolution rate is directly proportional to the surface area of the solid, and reducing the particle size

increases the surface area, reducing the particle size increases the dissolution rate. Although micronization results in increased surface area causing particle aggregation, which can negate the benefit of micronization and is an expensive manufacturing step, it does have the significant benefit of increasing the dissolution rate of relatively water insoluble drugs, such as omeprazole.

The formulation may contain suitable flavoring agents for use herein including, but not limited to, wintergreen, orange, grapefruit, chocolate, and cherry-raspberry. The amount of flavouring present in the formulation may be from about 0.1% to about 5.0% by weight of the composition.

The solid formulations may optionally contain suitable disintegrants such as, but not limited to, sodium starch glycolate [Explotab®], crosslinked polyvinylpyrrolidone, corn starch, acacia , Croscarmellose of sodium [Ac-di-sol®], sodium carboxymethylcellulose, veegum, or alginates. The amount of disintegrant present may be from about 1% to about 10.0% by weight of the composition.

The formulation may also include additional diluents or fillers which are preferably swellable agents, and may include, but are not limited to, various grades of microcrystalline cellulose, such as Avicel PH101, Avicel PH102, & Avicel PH200; corn starch; or Starch 1500. The amount of diluent or filler present in the formulation may be from about 1% to about 90.0% by weight of the composition.

The dosage form may also optionally contain suitable lubricants or wetting agents, such as but not limited to, magnesium stearate, stearic acid and its pharmaceutically acceptable alkali metal salts, calcium stearate, sodium stearate, Cab-O-Sil, Syloid, sodium lauryl sulfate, sodium chloride, magnesium lauryl sulfate or talc. Preferably, a suitable lubricant is magnesium stearate or stearic acid. Preferably, a suitable wetting agent is a surfactant, such as sodium lauryl sulfate. The amount of lubricant present in the formulation may be from about 0.1% to about 10.0% by weight of the composition, wherease the amount of wetting agent may be from about 0.1 – 20% by weight.

The formulation may also include additional binding agents, such as polyvinylpyrrolidone, (PVP), or Povidone 29K/32. The amount of binding agent present in the formulation may be from about 0.1% to about 30.0% by weight of the composition.

The formulation may also include coloring agents, or pigments, such as FD&C or D&C approved lakes and dyes, iron oxide and titanium dioxide. The amount of pigment present may be from about 0.1% to about 5.0% by weight of the composition.

Additional other conventional pharmaceutical diluents or excipients may also be included, as needed, in the admixture. Suitable excipients which may be employed include, for example, fillers, binders, lubricants, binders, compression aids, and wetting agents. To further assist patient compliance, the formulation may also contain sweeteners such as various natural sugars, aspartame, sodium cyclamate and sodium saccharinate; in addition to the flavorants. The amount of sweetner present may be from about 0.1% to about 20.0% by weight of the composition.

The formulations may also be manufactured in a concentrated form, such as an effervescent tablet, for oral administration upon admixture with water. Suitable effervescent formulations for use herein are well known in the art.

The following data illustrates the utility of the pharmaceutical composition of the present invention.

Comparison of onset of acid inhibition between omeprazole alone and the omeprazole – bicarbonate combination.

Khoury, *et al.* studied onset of acid inhibition following a single postprandial administration of omeprazole 10 or 20 mg in healthy volunteers. Khoury, et al., *Am. J. Gastroenterol.* ***93:*** 1619, (1998). The effect of omeprazole was compared with ranitidine, 75 and 150 mg. Gastric acid was measured via an intragastric pH probe. The design was a randomized crossover in 24 subjects. A standardized breakfast was consumed, drug was administered once intragastric pH returned to pH < 2.0, and intragastric pH recorded for 6 hr. Omeprazole, at both 10 and 20 mg failed to elevate intragastric pH to values ≥ 3.0 during the 6 hour postprandial recording period. In contrast, ranitidine 75 mg and 150 mg elevated intragastric pH > 3.0 within 178 and 145.5 min of dosing, respectively, and sustained pH > 3.0 for 2 and 3 hours of the recording period. Hence in this study, a single postprandial dose of 10 or 20 mg omeprazole had no effect on intragastric acidity for 6 hours following administration in healthy individuals.

Similarly, Decktor, *et al.* compared effects of single administrations of omeprazole 10 or 20 mg, famotidine 10 mg and placebo on meal-stimulated gastric acid secretion. Decktor, et al., *Am. J. Gastroenterol.* ***92:*** 1588, (1997). In a blinded, placebo-controlled cross-over study, each of 12 subjects randomly received the treatments one hour prior to intragastric infusion of a liquid peptone meal (600 ml 8% peptone, pH 4.0) designed to maximally stimulate acid output. Intragastric pH was maintained at pH 4.0 by continuous infusion of NaOH. Compared to placebo,

onset of significant acid antisecretory activity was observed 45 min, 75 min and 90 min following meal infusion for famotidine, omeprazole 20 mg and omeprazole 10 mg respectively. Over a 5 hr recording period. 10 mg famotidine reduced the amount of titrant required to maintain pH at 4.0 by 81%, while reductions of 56% and 27% were obtained with 20 mg and 10 mg omeprazole respectively. Famotidine 10 mg had a significantly faster onset of action and significantly greater antisecretory effect than omeprazole

The Phillips U.S. patent No. 5,840,737 in contrast, reports that single administration of bicarbonate + omeprazole elevates intragastric pH in critically ill patients from 3.0 ± 0.7 to 7.0 ± 0.6 within 2 hours after dosing. The dose was 20 mEq ANC provided by bicarbonate and a 40 mg omeprazole dose. Neutralization was then maintained by single daily administration of omeprazole (10 mEq ANC + 20 mg omeprazole) over the course of the study.

Lack of Effect of omeprazole in prevention of meal-induced heartburn

Decktor recently reported a single administration of omeprazole 10 or 20 mg failed to prevent meal-induced heartburn. Decktor, et al., *Am. J. Gastroenterol.* ***93:*** 1614, (1998). 385 subjects with a history of food-induced heartburn participated in a single-dose, parallel, blinded, randomized, placebo-controlled trial. 60 minutes prior to receiving a standardized heartburn-inducing meal (chili and soft drink), subjects received either placebo, 10 mg famotidine (Pepcid AC), omeprazole 10 mg or omeprazole 20 mg. Subjects rated their heartburn symptom severity on a VAS scale beginning immediately prior to the meal, and at 30 min. intervals for 3 ½ hr postprandially. Compared to placebo, neither dose of omeprazole significantly prevented or reduced postprandial heartburn; 54, 52 and 55% of subjects treated with placebo, 10 mg omeprazole or 20 mg omeprazole reported moderate-to-severe post-prandial heartburn symptoms. In contrast, 34% of subjects treated with famotidine were heartburn free, and only 27% reported moderate to severe symptoms (consistent with previously published trials). 64% of subjects reported relief from 10 mg famotidine as good or excellent, compared to 40%, 42% and 47% treated with placebo, 10 mg omeprazole and 20 mg omeprazole, respectively ($p < 0.03$ vs. famotidine). Neither dose of omeprazole differed significantly from placebo for any efficacy parameter. This study showed a clear performance advantage for famotidine over omeprazole in prevention of meal-induced heartburn symptoms.

The present invention is directed to the recognition that a 10 or 20 mg dosage of omeprazole and a preferred acid neutralizing capacity of a bicarbonate salt is/will be sufficient to induce relief of heartburn symptoms without requiring additional dosing of the bicarbonate salt.

Study to prove effectiveness of a combination therapy in heartburn relief and prevention.

A suitable study involves administration of a provocative meal (chili, soft drink) to individuals who report suffering from meal-induced heartburn, and whose heartburn symptoms can be reproduced by the provocative meal and responds to antacid/acid neutralization treatment. Following development of heartburn, usually within 30 – 60 min of eating the meal, the combination of omeprazole and bicarbonate is administered in a randomized, blinded manner (10 – 20 mL containing 10 – 20 mEq (ANC) bicarbonate and 10 –20 mg omeprazole). Control treatments include bicarbonate alone, omeprazole alone, and placebo. Both the combination and bicarbonate treatments will provide rapid relief of heartburn symptoms, while lesser relief is attained with omeprazole and placebo (no difference between the latter treatments in degree of relief). A second heartburn provoking meal is then consumed at least 4 hours after the first meal, but no further treatments are administered. Those subjects who receive omeprazole-containing treatments after the initial meal experience a reduction in heartburn symptoms to the second meal. Subjects who receive antacid alone (bicarbonate) or placebo treatment with the first meal are expected to have fully recurrent symptoms to the later meal. Hence, the combination of bicarbonate + omeprazole provides for a rapid onset and a prolonged duration of heartburn relief.

All publications, including but not limited to patents and patent applications, cited in this specification are herein incorporated by reference as if each individual publication were specifically and individually indicated to be incorporated by reference herein as though fully set forth.

The above description fully discloses the invention including preferred embodiments thereof. Modifications and improvements of the embodiments specifically disclosed herein are within the scope of the following claims. Without further elaboration, it is believed that one skilled in the are can, using the preceding description, utilize the present invention to its fullest extent. Therefore, the Examples

herein are to be construed as merely illustrative and not a limitation of the scope of the present invention in any way. The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows.

What is Claimed is:

1. A method of treating or preventing heartburn symptoms in a human in need thereof, which method comprises administering to said human a pharmaceutical composition comprising an effective amount of a proton pump inhibitor and an effective acid neutralizing amount of an alkali metal bicarbonate salt.

2. The method according to Claim 1 wherein the proton pump inhibitor is omeprazole, lansoprazole, pantoprazole, perprazole, or rabeprazole, or salts, isomers, enantiomers or derviatives thereof.

3. The method according to Claim 2 wherein the proton pump inhibitor is omeprazole.

4. The method according to Claim 3 wherein the dose of omeprazole is from about 10 to about 20mg.

5. The method according to any one of Claims 1 to 4 wherein the bicarbonate is sodium or potassium bicarbonate or a mixture thereof.

6. The method according to Claim 5 wherein the bicarbonate is sodium bicarbonate.

7. The method according to Claim 6 wherein the bicarbonate is administered in an ANC amount of about 18 to 40mEq.

8. The method according to Claim 1 wherein the proton pump inhibitor and alkali metal bicarbonate salt are administered in a solid unit dosage form.

8. The method according to Claim 8 wherein the dosage form is a compressed tablet.

9. The method according to Claim 8 wherein the dosage form is a capsule.

10. The method according to Claim 7 wherein the proton pump inhibitor is omeprazole and in a dosage range of from about 10 to about 20 mg.

11. The method according to Claim 1, wherein the pharmaceutical composition is a single unit dosage form administered in a volume of between approximately 10 ml and 20 ml of an aqueous solution.

12 The method according to Claim 11 wherein the dosage form is a sachet administered with water.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/18896

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :A61K 33/00, 31/44
US CL :424/717; 514/339
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 424/717; 514/339, 819

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,840,737 A (PHILLIPS) 24 November 1998, see entire document.	1-12

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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