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Rescue treatment and prevention of asthma using magnesium throat lozenges: Hypothesis for a mouth–lung biologically closed electric circuit [☆]

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Summary In the rescue treatment of acute asthma, injected and inhalant magnesium are relatively weak having demonstrated value only in severe illness, although theoretical and laboratory considerations suggest that magnesium should be strongly effective as an asthma rescue agent. It was hypothesized that a mouth–lung biologically closed electric circuit (BCEC) exists capable of nearly instantly transporting positively charged magnesium ions from the mouth and throat into the lungs. One hundred milligram magnesium (magnesium chloride) 4-g throat lozenges producing 100+ mM magnesium ion concentration in saliva were tested to determine if they had beneficial effects in asthma rescue and prevention. Subjects were selected based solely on need for asthma rescue, and lozenges were used as needed. Case histories are presented showing the nearly immediate effect of magnesium chloride throat lozenges in terminating and preventing asthma attacks. Throat lozenges containing magnesium chloride produced much more rapid and stronger benefits than has been reported for inhaled and injected magnesium. An added benefit from magnesium chloride lozenge treatment of asthma was relaxation. In this first report of its kind, magnesium chloride throat lozenges appeared to provide rescue benefits in the treatment of asthma equivalent to pharmaceutical asthma drugs. Countering these benefits, strong ionic magnesium solutions greatly increase rhinovirus, herpesvirus and *Candida albicans* in vitro, and appear to worsen these infections in humans. Magnesium lozenges releasing concentrated magnesium ions appear contraindicated during common colds, oral herpes infections, chronic rhinosinusitis, oral and respiratory infections in general, and their use must immediately be terminated if respiratory or oral symptoms worsen. Double-blind, placebo-controlled, clinical trials in people without respiratory or oral infections are needed to determine magnesium lozenge safety, and the extent by which drug treatment of asthma can be reduced.

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Introduction

Asthma is characterized by inflammation of the air passages resulting in the temporary narrowing of the airways that transport air from the nose and mouth into the lungs. Asthma symptoms can be caused by allergens or irritants that are inhaled

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into the lungs resulting in inflamed, plugged and constricted airways. Some asthma is intrinsic, meaning that other causes such as cold air, exercise or emotion are causative. Symptoms include difficulty breathing, excessive mucus, mucus plug and phlegm production, wheezing, coughing and tightness in the chest. According to the Asthma and Allergy Foundation of America in Washington, DC, in the United States each day over 30,000 people have an asthma attack, with about 5000 people requiring emergency room attention with as many as 14 deaths per day. Asthma accounts for about one-fourth of all emergency room admissions. One in 15 Americans has asthma, with one-half of all asthma cases being caused by allergic reactions, and the prevalence of asthma is increasing. It is the most chronic condition for American children affecting 7–10% of them, while asthma affects adults by about one-half that incidence. Asthma incidence is correlated with poverty, air quality, allergens and malnutrition. Cost of asthma is about \$18 billion per year, with \$10 billion being for hospitalization and \$5 billion in indirect costs for illness and death. Asthma is a leading cause of work absenteeism and impaired work performance.

Many rescue treatments for asthma exist including drugs in inhaled and pill form. Asthma medications inhaled into the lungs are used to rescue the patient from an asthma attack. They include beta-agonists such as short- and long-acting bronchodilators, corticosteroids, cromolyn and nedocromil. Pill forms include leukotriene modifiers and theophylline. Each of these drugs has its place in the treatment of asthma. However, most if not all, have side effects that can make long-term treatment problematic without careful medical supervision and treatment of possible side effects.

Additionally, magnesium inhalants [1] and magnesium injections [2] have been used to treat asthma for many years although the beneficial effects occur over a period of 1/2–4 h. Dietary deficiencies of magnesium are known to be correlated with asthma attacks [3], however magnesium therapy generally has been shown useful only in those people with very severe asthma exacerbations, and there is disagreement on the utility of inhaled magnesium. Thus, it has been suggested that critically ill asthmatic patients as a group are most likely to benefit from magnesium therapy.

Magnesium has many functions vital in the treatment and prevention of asthma. Magnesium is well known to be a natural antihistamine required for proper function of the immune system. Magnesium decreases the uptake of calcium ions by bronchial smooth muscle cells, producing bronchodilation. Magnesium inhibits mast cell degranulation, thus

inflammatory mediators such as histamine, thromboxanes, and leukotrienes are reduced by its presence, particularly when magnesium is present in excess. Magnesium also inhibits acetylcholine release from motor nerve terminals and depresses muscle fiber membrane excitability, helps activate adenylate cyclase, and decreases neutrophil superoxide production [1–3]. Magnesium deficiency associated with histamine release and eosinophilia has been reported in patients with bronchial asthma [4].

Clearly, magnesium should be beneficial in the rescue treatment of asthma, the question remained how to best use it, and the throat lozenge method had not previously been considered or tested. In all other cases for pharmaceutical drugs to effect rescue from asthma symptoms, there must be direct contact. If magnesium were released from throat lozenges in the treatment of asthma, it would not flow into the trachea, bronchial tubes and lungs by classical means.

Non-classically, Björn E. W. Nordenström while he was Chairman of the Department of Radiology at the Karolinska Institute and President of the Nobel Assembly that selects the Nobel Laureate for Physiology or Medicine described biologically closed electric circuits (BCEC) as an additional circulatory system for metallic ions [5]. In the same manner that there is a mouth–nose BCEC moving positively charged metallic zinc ions from the mouth into the nose in the treatment of common colds [6], it is hypothesized that there is a similar mouth–lung BCEC moving positively charged magnesium ions directly from the mouth and throat into the lungs. Although existence of the mouth–nose BCEC was confirmed by the author by use of a volt–ohm meter to determine the voltage between the mouth and the interior of the nose, no non-invasive means of determining the mouth–lung BCEC voltage is immediately evident. Voltages between 60 and 120 mV move electrons and positively charged zinc from the mouth into the nose. Similarly, in the treatment of asthma with magnesium it is hypothesized that there are voltages in the mouth–lung BCEC moving electrons and positively charged magnesium directly and nearly immediately from the mouth and throat into the lungs, bypassing classical circulatory systems.

In the case of the mouth–nose BCEC, the electrical resistance between the mouth and the nose varies considerably and with medical importance [6]. For example, individuals with frequent colds, allergies, and rhinitis have a low resistance value, between 1 and 10 k Ω . Those with an average number of colds and few or no allergies have resis-

tances between 40 and 60 k Ω . People-particularly physicians-who are immune to common colds and have no allergies have values between 100 and 500 k Ω . Similar electrical resistances in asthma between the mouth and lungs are hypothesized, with low resistance values resulting in frequent incidences of asthma and chest congestion and high resistance resulting in immunity to asthma and chest congestion, regardless of the allergen load.

In the case of positively charged ionic zinc that is introduced into the nasal passages, it is repelled by the like charge of the nasal tissues, going down the throat with mucus while intra-nasally applied positively charged ionic zinc is repelled [6]. Similarly, positively charged ionic magnesium (magnesium sulfate for example) inhaled into the lungs is repelled rather than absorbed in the treatment of asthma, while positively charged ionic magnesium applied in the mouth and throat is transported into the lungs. These mechanisms are hypothesized to be part of the natural defense systems of the nose and lungs, which protects them from all inhaled positively charged particles. Injected magnesium is routed by classical mechanisms familiar to all. Alternatively, one may attribute the rapid absorption of ionic magnesium in the mouth and throat to their extensive vascular system, in much the same way that nitroglycerin is absorbed.

To test the hypothesis that magnesium throat lozenges would be beneficial in the treatment of asthma, the author had manufactured by Summa RX Laboratories, Ft. Worth, Texas, magnesium chloride (positively charged and highly ionizable) throat lozenges. He first tested a lozenge during one of his own asthma attacks. The asthma attack started to lessen within a few seconds and ended within a few minutes, indicating that there had been a strong pharmacological effect of magnesium since his asthma attacks routinely lasted for hours. Based upon this observation, the author continued to use magnesium throat lozenges to treat his asthma, and he found the benefit to be highly replicable. Other people were shown how to treat their asthma using magnesium lozenges with similar success, leading to this first report of their efficacy.

The hypothesis tested herein asks whether or not magnesium chloride throat lozenges and other, less-ionizable magnesium lozenge compositions are effective in asthma rescue and prevention. After discussing the possible benefits and apparent lack of side effects with the subjects and after informed consent was obtained, the following otherwise healthy subjects tested magnesium lozenges for their asthma.

Materials and methods

Highly ionizable 100-mg magnesium (magnesium chloride) 4-g throat lozenges and some other magnesium compositions were used for preliminary asthma research, effects were observed and the results recorded. The primary goal was to provide treatment as needed to terminate and to prevent attacks.

Case 1: A single 4-g compressed lozenge (dextrose, glyceryl monostearate, silica gel and peppermint oil) containing 400 mg of magnesium chloride (100 mg elemental magnesium) was used to treat intrinsic asthma in a 65-year-old man. His asthma symptoms were initiated by cold air and cold feet. Awakening in the early morning hours and walking across a cold floor barefoot to the bathroom always caused immediate asthma with chest congestion, phlegm production and coughing, making resumption of sleep difficult or impossible. He was given magnesium chloride lozenges to keep on his bedstead, and he started to dissolve a lozenge upon awakening and prior to touching the cold floor with his feet.

Case 2: Four hundred mg of magnesium chloride (100 mg magnesium) in a 4-g lozenge was used to treat an attack of acute asthma consisting of wheezing and extreme shortness of breath. The patient, a female in her early 40s, allowed the lozenge to dissolve in her mouth after finding that she had misplaced her prescription asthma inhaler.

Case 3: The woman of Case 2 while working all day in her garden had six asthma attacks (wheezing and shortness of breath) in a single day. Instead of using her prescription asthma inhaler, she used magnesium chloride (100 mg magnesium) throat lozenges.

Case 4: The man of Case 1 had been using 500 mg of magnesium as a dietary supplement for 7 years, which had little or no effect on frequency or severity of asthma symptoms. He changed to five 100 mg magnesium (magnesium chloride) throat lozenges per day to try to prevent asthma.

Case 5: A man used a hard candy containing magnesium chloride, sugar and corn syrup (100 mg magnesium per 4-g) to treat and prevent asthma. He used the lozenges each time he felt an asthma attack coming on in an effort to prevent them.

Case 6: A 65-year-old man used 200 mg of magnesium from a magnesium glycinate (partly ionizable) dietary supplement tablet used as a throat lozenge to treat asthma consisting of wheezing, chest tightness and severe congestion.

Case 7: A man used two 400-mg magnesium oxide (relatively non-ionizable) tablets as throat lozenges (241.3 mg magnesium each) early in the morning as a treatment for asthma, chest congestion and cough.

Results

Results of oral retention of magnesium chloride by the above subjects were uniformly and surprisingly effective in the rescue treatment and prevention of asthma without any observed side effects or sequelae, although other magnesium compounds produced varied and reduced benefits.

Case 1: Even though the lozenge was not completely used by the time he returned from the bathroom, he did not develop asthma symptoms and was able to immediately return to sleep after removing the lozenge from his mouth, perhaps resulting from dissolved magnesium remaining in his mouth.

Case 2: Before the lozenge had completely dissolved, the asthma attack ended and did not return that day effecting a rescue. A further benefit noted was a feeling of relaxation, something that was not possible from use of her prescription rescue inhaler.

Case 3: Although she was severely allergic to the pollens in her garden, each of her asthma attacks ended within a few minutes upon starting magnesium chloride lozenges. She required no asthma drugs that day. Her day was quite relaxed. There may be an element of exercise-induced asthma in this case.

Case 4: Five throat lozenges daily completely prevented his asthma symptoms. This suggests that it is not the amount of magnesium ingested per day, but the means of ingesting magnesium that is important in treating and preventing asthma.

Case 5: Treatment with magnesium lozenges resulted in prompt rescue. He used four lozenges per day to remain free of asthma symptoms.

Case 6: Treatment with magnesium glycinate resulted in slower improvement than magnesium chloride but asthma rescue treatment was effective.

Case 7: The magnesium oxide lozenges, even when several were used together, were modestly beneficial in the treatment of his asthma symptoms due to slowness and weakness of the response and the large amount needed.

There are many other instances of efficacy not reported here since these subjects and others quickly became dependent upon magnesium lozenges and are no longer using drugs to treat their asthma. Opportunity to test magnesium lozenges specifically in exercise-induced asthma in athletes did not arise, but it is expected that the lozenges would be equally effective.

No failures of 100 mg magnesium (magnesium chloride) lozenges for asthma are known, while magnesium oxide lozenges were only slightly beneficial, and magnesium glycinate had an intermediate benefit. The poor performance of magnesium oxide in Case 7 further supports the notion that the magnesium compound needs to be highly ionizable for efficacy. Magnesium oxide treatment to be effective required much larger doses and provoked diarrhea. From Case 4, it is now evident that it is not the total amount of dietary magnesium, but the means of ingestion that is responsible for rapid asthma rescue.

The hypothesis that magnesium chloride throat lozenges are effective in the rescue of asthma and the prevention of asthma appears supported from these and other results. Neither asthma drugs nor medical care were needed during use of magnesium chloride lozenges. Although the case history method of reporting medical progress has major flaws, this report is believed to correctly portray the surprisingly strong benefit of magnesium chloride throat lozenges in the rescue and prevention of asthma. The results were so striking and so different than expected based upon the slow response of asthma to inhaled and injected magnesium, that had this data been compared to placebo-treatment, surely the results would have been statistically significant.

Discussion

Magnesium chloride is known to be essentially 100% ionizable and bioavailable at physiologic pH, while magnesium oxide is not believed bioavailable [7–10]. Magnesium glycinate and many other magnesium compounds are less ionizable than magnesium chloride and more ionizable than magnesium oxide at physiologic pH [10]. Magnesium compounds less ionizable than magnesium chloride are needed in greater amounts than magnesium chloride and may

increase the risk of side effects such as diarrhea. Magnesium glutamate and magnesium aspartate, having intermediate ionization characteristics are neurotoxic. Depressives have a heightened sensitivity to these amino acid ligands and they may cause or worsen their depression or anxiety [11]. Since both depression [11] and asthma [3,12] have significant magnesium deficiency components, the combination can be lethal [13]. Magnesium lozenges should also be a major improvement over swallowed magnesium in treating depression, cardiovascular disease and other magnesium deficiency symptoms.

Magnesium lozenge compositions to be developed by others may inadvertently produce neutrally or negatively charged magnesium species at physiologic pH, which will be ineffective in the rescue and treatment of asthma. Based upon experience with zinc lozenges for common colds [14], there is a likelihood that non-ethical commercial interests will favor taste, flavor and mouth-feel over efficacy. However, magnesium chloride lozenges are generally pleasant tasting in both compressed and hard boiled candy forms, and do not require food acid flavor-masking. Solution chemistry consideration of availability of positively charged magnesium ions at physiologic pH is vital for any composition other than magnesium chloride in simple candy bases without additive food acids.

Magnesium dietary supplements have been used in faltering attempts to provide nutritional support to prevent asthma, and there is a belief that dietary deficiency of magnesium is strongly implicated in causing asthma [3]. Magnesium deficiency is notoriously difficult to correct, and the lozenge method may be the best method of treating magnesium deficiency without use of injections. This notion is supported by the observation that instances of asthma attacks seem to decline with prolonged use of magnesium lozenges. This further suggests that asthma might be curable by sustained daily treatment with four to six 100 mg magnesium lozenges over a period of 3–6 months. Since about 70% of the American public is deficient in magnesium, but only about 6–7% of Americans have asthma, there is clearly more to the issue of asthma than dietary magnesium deficiency. However, magnesium deficiency aggravates asthma, and it is a necessary precondition for asthma. Low electrical resistance in the mouth–lung BCEC should now be added to the list of causative agents for asthma attacks.

The United States Recommended Dietary Allowance (RDA) for magnesium is 400 mg per day for adults. Most Americans and Europeans ingest less than the RDA of magnesium, with men averaging about 80% of the RDA, and women averaging only 70%, resulting in many chronic health issues. Since

magnesium is an essential human nutrient, it is inherently safe to use in throat lozenges for asthma in people in otherwise good health, and it has no known side effects at effective doses less than a total of 600 mg total supplemental per day in healthy adults. Higher supplemental daily doses may cause loose bowels in healthy adults, and much higher doses may cause diarrhea and overdose. Dosages for asthmatic children might be smaller, more consistent with the RDA for their age and size, but not necessarily.

Contraindications

Magnesium lozenges contraindications include hypermagnesemia, severe kidney disease, use of certain antibiotics and some other drugs and during common colds, which may be greatly worsened by magnesium. The compressed magnesium chloride lozenges used in this research produced over 100 mM ionic magnesium salivary concentration. Of serious concern, 30 mM ionic magnesium increased rhinoviral count by up to 310 times in vitro [15]. Consequently, magnesium lozenges must never be used during common colds in order to prevent severe worsening of common cold symptoms. For example, a 30-year-old woman used a single 100 mg magnesium (magnesium chloride in a 4-g candy lozenge) lozenge on the first day of a cold followed by zinc acetate lozenges (14 mg zinc-6 mM) each two wakeful hours. The cold lasted 14 days, which is much longer than usually results from using these properly made zinc acetate lozenges [14]. Since magnesium double herpes virus titer in vitro, oral herpes infections may be worsened by ionic magnesium [16]. Added magnesium was required for exponential growth of *Candida albicans* yeast cells, and a case of chronic rhinosinusitis occurred upon use of a few magnesium throat lozenges [17]. Clearly, it is vital to avoid using magnesium throat lozenges during common colds, herpes and *Candida albicans* infections such as chronic rhinosinusitis, for which humming-induced nitric oxide appeared therapeutic [18], and it is imperative to stop magnesium lozenge treatment if respiratory or oral symptoms worsen. Although magnesium lozenges also rapidly improve upper respiratory allergy symptoms, they must not be used for that purpose due to the possibility of confusion with rhinoviral common colds resulting in worsened colds. No information was found concerning the effect of magnesium on influenza or other viral, bacteriologic or fungal respiratory diseases, but it is suggested that magnesium lozenges not be used during any respiratory or oral infection.

Conclusions

Magnesium chloride throat lozenges produced vastly better results than inhaled, injected or oral magnesium in the treatment of asthma and chest congestion in otherwise healthy people, most likely due to the advantages provided by the mouth–lung BCEC. Best results were obtained when treatment was commenced immediately upon noticing an asthma attack coming on, although treatment appeared effective at any stage of an attack. Efficacy was greater using highly ionized magnesium chloride rather than poorly ionizable compounds. Clinical trials are warranted and recommended in people without respiratory infection. Side effects of treatment such as worsening common colds, oral herpes and *Candida albicans* may limit utility of this treatment.

References

- [1] Blitz M, Blitz S, Hughes R, Diner B, Beasley R, Knopp J, et al. Aerosolized magnesium sulfate for acute asthma: a systematic review. *Chest* 2005;128:337–44.
- [2] Rowe BH, Bretzlaff JA, Bourdon C, Bota GW, Camargo Jr CA. Intravenous magnesium sulfate treatment for acute asthma in the emergency department: a systematic review of the literature. *Ann Emerg Med* 2000;36:181–90.
- [3] Tong GM, Rude RK. Magnesium deficiency in critical illness. *Intens Care Med* 2005;20:3–17.
- [4] Chyrek-Borowska S, Obrzut D, Hofman J. The relation between magnesium, blood histamine level and eosinophilia in the acute stage of the allergic reactions in humans. *Arch Immunol Ther Exp Warsz* 1978;26:709–12.
- [5] Nordenström BE. Biologically closed electric circuits. Clinical, experimental and theoretical evidence for an additional circulatory system. Stockholm: Nordic Medical Publications; 1983. p. 112–72.
- [6] Eby GA, Halcomb WW. Ineffectiveness of zinc gluconate nasal spray and zinc orotate lozenges in common-cold treatment: a double-blind, placebo-controlled clinical trial. *Altern Ther Health Med* 2006;12:34–8.
- [7] Firoz M, Graber M. Bioavailability of US commercial magnesium preparations. *Magnes Res* 2001;14:257–62.
- [8] Walker AF, Marakis G, Christie Byng M. Mg citrate found more bioavailable than other Mg preparations in a randomized, double-blind study. *Magnes Res* 2003;16:183–91.
- [9] Lindberg JS, Zobitz MM, Poindexter JR, Pak CY. Magnesium bioavailability from magnesium citrate and magnesium oxide. *J Am Coll Nutr* 1990;9:48–55.
- [10] Furia Thomas E. Chapter 6-Sequestrants in foods. In: CRC handbook of food additives. Cleveland: Chemical Rubber Company; 1972.
- [11] Eby GA, Eby KL. Rapid recovery from major depression using magnesium treatment. *Med Hypotheses*, in press.
- [12] Hashimoto Y, Nishimura Y, Maeda H, Yokoyama M. Assessment of magnesium status in patients with bronchial asthma. *J Asthma* 2000;37(6):489–96.
- [13] Miller BD. Depression and asthma: a potentially lethal mixture. *J Allergy Clin Immunol* 1987;80(3 Pt 2):481–6.
- [14] Eby GA. Zinc lozenges: cold cure or candy? Solution chemistry determinations. *Biosci Rep* 2004;24:23–39.
- [15] Fiala M, Kenny GE. Effect of magnesium on replication of rhinovirus HGP. *J Virol* 1967;1:489–93.
- [16] Siddiqui YM, al-Ahdal MN. Plaquing efficiency of herpes simplex virus type 1 with a defined agar overlay. *New Microbiol* 1993;16:95–8.
- [17] Holmes AR, Cannon RD, Shepherd MG. Effect of calcium ion uptake on *Candida albicans* morphology. *FEMS Microbiol Lett* 1991;61:187–93.
- [18] Eby GA. Strong humming for one hour daily to terminate chronic rhinosinusitis in four days: a case report and hypothesis for action by stimulation of endogenous nasal nitric oxide production. *Med Hypotheses* 2006;66(4):851–4.

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