



Novel Facilitation of Magnesium Uptake by Choline Citrate

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Background

Magnesium is the...

- Fourth most abundant cation in the human body
- Second most abundant cation inside cells (after potassium)
- Activating cofactor for over 300 intracellular enzymes

Hypomagnesemia is associated with...

Condition

- Accelerated atherosclerosis
- Hypertension
- Coronary spasm
- Cardiac irritability and arrhythmias
- Preeclampsia of pregnancy
- Headache
- Pain syndromes
- Hypokalemia

Because

Less repair; more free radical damage; often associated with inflammation due to toxic or immunotoxic effects of toxic minerals (Pb, Hg As, Cd, Ni) or other immune reactivities. Less Mg 2nd message to counter Ca; toxic and immunotoxic effects of toxic minerals or other immunoreactive substances. Increased reactivity from relative Ca excess; platelet reactivity, activated by immune complexes or endothelial damaged blood vessel walls, can lead to blood flow impeding clumps. Oxidized fats potentiate this platelet reactivity. Impaired Ca/Mg ratio often with distress linked adrenalines and cortisol sensitizing the heart cells. Impaired Ca/Mg ratio; insulin / glucose / energy systems often in dysregulation from toxins (hormone dysregularity) and immunoreactivities. Increased reactivity from relative Ca excess in the presence of cellular acidosis. Increased reactivity from relative Ca excess with increased substance P release. Impaired Na/K-ATPase pump function;

- Hypocalcemia
 - Impaired magnesium uptake
 - Muscle irritability and spasm
- toxic and immunotoxic effects of toxic metals and other immunoreactivities
 Impaired Ca/Mg-ATPase pump function
 Impaired Ca/Mg-ATPase pump function; see below for ways to overcome this uptake block
 “Restless leg syndrome” 2° to low cell Mg

Ionized magnesium is the active form of the element in physiologic functions. Ionized magnesium is the free form of the element.

- Total magnesium minus protein bound and ligand complexed magnesium yields the ionized magnesium. Ion-specific electrodes can measure ionized magnesium specifically. Ionized magnesium is in dynamic equilibrium with intracellular, bioactive magnesium. Thus, measurement of ionized magnesium is a more predictive measure of intracellular, functional magnesium status than total Mg, RBC Mg, or sweat Mg in complex cases. Use of a provocative test of tissue Mg status with D-Penicillamine or similar chelating agent is recommended.

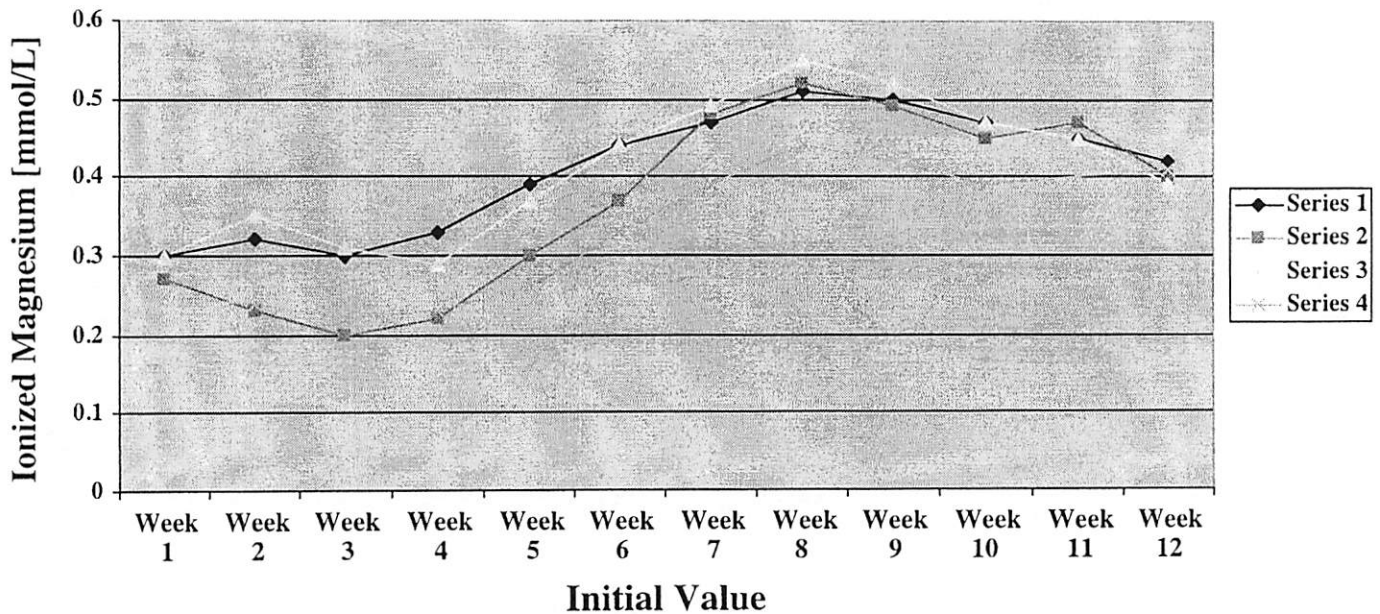
Impact of Choline Citrate on Magnesium Uptake

In light of the above and to assess the impact of concurrent intake of choline citrate and ionized, soluble magnesium salts on magnesium uptake, the following studies were undertaken:

People who had conditions (as above) associated with low magnesium were assessed. The following conditions were observed:

1. Clinical assessments were done over a period of one month. **PERQUE Magnesium Plus Guard** alone was followed by one month of **PERQUE Choline Citrate** alone followed by one month of **PERQUE Magnesium Plus Guard** along with concurrent administration of **PERQUE Choline Citrate**. Functional, clinical end points were assessed.
2. Laboratory assessment was carried out by assessing ionized magnesium in people who took **PERQUE Magnesium Plus Guard** alone for four weeks followed by four weeks of **PERQUE Choline Citrate** followed by four weeks of concurrent **PERQUE Magnesium Plus Guard** and **PERQUE Choline Citrate**. The combination regimen was continued if substantially different improvement was observed compared to the initial assessment phases. Laboratory quantitation of ionized magnesium was the end point assessed.

Influence of Choline Citrate on Ionized Magnesium



In other studies, the role of choline citrate on magnesium levels in the absence of PERQUE Magnesium Plus Guard was evaluated. A modest but statistically insignificant increase in magnesium was noted over a 30-day period of evaluation.

Conclusions:

1. A previously unknown and unanticipated benefit is observed in the form of facilitated magnesium uptake when choline citrate is concurrently administered.
2. Choline citrate alone does not substantially raise ionized magnesium levels.
3. In some people with clinical magnesium need, even the most soluble and ionized forms of magnesium are less available possibly because of inhibition of the Ca/Mg ATPase pump.
4. A proposed mechanism of action is the formulation of micelles containing two molar equivalents of magnesium and choline along with three molar equivalents of citrate, thus forming an electrically neutral complex.

For more information about this study and other double-blind, placebo-controlled studies conducted by PERQUE LLC, please contact PERQUE's Client Services Department at 800.525.7372.

Clinical assessments:

Case #1:

A 26-year-old man suffered from supraventricular arrhythmias, which were unresponsive to medication, and despite a detailed medical work-up, were determined to be “idiopathic.” The patient was instructed to count the number of irregular heartbeats (IHB) over a two-minute period on rising and before bed.

	AM	PM	TOTAL
Month 1 (average)	13	22	35
Month 2 (average)	11	27	38
Month 3 (average)	1	3	4

This illustrates the value of combining alkalization, ATP energy enhancement, and facilitated Mg uptake.

Case #2

A 72-year-old woman suffered from ectopic heartbeats, which were unresponsive to medication, and despite a detailed medical work-up, were determined to be “idiopathic.” The patient was instructed to count the number of irregular heartbeats (IHB) over a two-minute period on rising and before bed.

	AM	PM	TOTAL
Month 1 (average)	18	20	38
Month 2 (average)	22	19	41
Month 3 (average)	1	2	3

Probable high anxiety induced adrenalines and cortisol contributed to this myocardial irritability.

Case #3

A 59-year-old man suffered from “restless legs” and intermittent leg cramps during sleep. The subject was asked to rate the intensity of the problem on a consistent rating scale with “0” indicating no problem and “100” indicating the most severe expression of the condition.

	Average intensity of leg cramp-related difficulty
Weeks 1-2	88
Weeks 3-4	83
Week 5	63
Week 6	44

Week 7	29
Week 8	12
Week 9	7

Long-standing metabolic acidosis with net acid excess in the cell can take months to repair and reload Mg stores in muscle cells. Immune complexes often potentiate “restless legs.” Measuring first AM urine pH addresses net acid excess.

In addition to these clinical assessments, the following laboratory evaluations are consistent with enhanced magnesium uptake when the correct magnesium salts are properly combined with high purity choline citrate.

A study of the influence of **PERQUE Magnesium Plus Guard** ± concurrent choline citrate on ionized magnesium in plasma compared with **PERQUE Magnesium Plus Guard** alone in people with apparent uptake block of magnesium was conducted.

The subjects were selected for signs of magnesium deficit including muscle irritability and fasciculation, benign cardiac irritability and/or moderate fibromyalgia pain that had previously been unresponsive to magnesium therapy.

Subjects were put on a fixed dose of **PERQUE Magnesium Plus Guard**, two (2) capsules with each meal [six (6) per day] for one month. For the second month, the same regimen was continued plus addition of one (1) teaspoon of **PERQUE Choline Citrate** in juice or water taken at the same time as the **PERQUE Magnesium Plus Guard** supplement. For the third month, the subjects continued the magnesium regimen without the additional choline citrate. Diet and fluid intake were kept consistent during the study interval.

Note: The reference range for ionized magnesium using this ion-specific electrode (NOVA) is 0.43 – 0.59 mmol/L. Measurements were made at the end of each study week.

Subject:	#1	#2	#3	#4
Results:	Ionized	Ionized	Ionized	Ionized
	Mg [plasma]	Mg [plasma]	Mg [plasma]	Mg [plasma]
Initial value	0.31 mmol/L	0.28 mmol/L	0.33 mmol/L	0.22 mmol/L
Week 1	0.30	0.27	0.30	0.25
Week 2	0.32	0.23	0.35	0.24
Week 3	0.30	0.20	0.31	0.22
Week 4	0.33	0.22	0.29	0.23
Week 5	0.39	0.30	0.37	0.26
Week 6	0.44	0.37	0.44	0.33
Week 7	0.47	0.48	0.49	0.39
Week 8	0.51	0.52	0.55	0.44
Week 9	0.50	0.49	0.52	0.42
Week 10	0.47	0.45	0.47	0.39
Week 11	0.45	0.47	0.45	0.40
Week 12	0.42	0.40	0.39	0.41

Examining data in graphic form is shown in the next table.