

## The Effect of Intravenous Magnesium Sulfate Treatment on Serum Calcium, Magnesium and Parathyroid Hormone Levels in Pregnancy<sup>1)</sup>

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### Zusammenfassung

Es steht fest, daß Kalzium ein wichtiger Regulator für die Funktion der Nebenschilddrüse ist. Es wurde gezeigt, daß auch Magnesium eine wichtige Rolle spielt. Zur weiteren Aufklärung der Wirkung von Magnesium-Sulfat auf Serum-Magnesium, totales Kalzium, ionisiertes Kalzium und Parathormon-Spiegel (PTH) wurden Serum-Konzentrationen dieser Parameter bei 9 schwangeren Frauen im 3. Trimenon gemessen, die intravenös Magnesium-Sulfat zur Behandlung der vorzeitigen Wehentätigkeit erhalten haben. Nach der Magnesium-Sulfat-Therapie stieg der Durchschnitts-Serum-Magnesium-Spiegel ( $\pm$  SD) signifikant nach  $\frac{1}{2}$  Stunde und blieb nach 1, 2 und 3 Stunden signifikant hoch. Die Parathormon-Konzentration fiel während der ersten halben Stunde rapide ab und blieb für 2 Stunden, trotz Hypokalzämie, unter dem Normalwert. Die Serum-Konzentration des totalen und ionisierten Kalziums fielen nach 3 Stunden signifikant unter den Normalwert. Unsere Ergebnisse lassen vermuten, daß Hypermagnesiämie die Parathormon-Sekretion bei schwangeren Frauen senkt und diese Unterdrückung trotz gleichzeitiger Hypokalzämie bestehen bleibt. Außerdem zeigen diese Resultate, daß eine Hypokalzämie in Verbindung mit einer Hypermagnesiämie auf die Unterdrückung des Serum-Parathormons zurückgeführt werden kann. Es wurden nur Schwangere mit EPH-Gestose-Komplex in dieser Studie aufgenommen.

### Summary

It is established that calcium serves as a principal regulator of the function parathyroid gland. Magnesium has also been shown to play an important factor. To further elucidate the effect of magnesium sulfate on serum magnesium, total calcium, ionized calcium and parathyroid hormone (PTH) level, we measured serum concentrations of these parameters in 9 third trimester pregnant women who receive intravenous magnesium sulfate for the treatment of premature labour. After magnesium sulfate therapy the mean ( $\pm$  SD) serum magnesium level rose significantly after  $\frac{1}{2}$  hour, remaining significantly high after 1, 2 and 3 hours. The concentrations of parathyroid (PTH) fell rapidly during  $\frac{1}{2}$  hour, remaining below base line for 2 hours, despite hypocalcemic state. Serum concentrations of total and ionized calcium dropped from normal basal level concentrations significantly respectively after 3 hours. Our results suggest that hypermagnesemia decreases the parathyroid hormone secretion in pregnant women and this suppression remained despite concomitant hypocalcemia. Furthermore the results demonstrated that hypocalcemia associated with hypermagnesemia may be due to the suppressive effects of serum parathyroid hormone (PTH). Only pregnant women with EPH-Gestosis complex were used in this study.

### Résumé

Le calcium est un des principaux régulateurs du fonctionnement des glandes parathyroïdes. De même, le magnésium s'est révélé être un facteur important. Afin de connaître l'effet du sulfate de magnésium sur la magnésémie, le taux sérique de calcium total et ionisé et celui de la parathormone (PTH), on a mesuré les concentrations sériques de ces divers paramètres au troisième trimestre de grossesse chez 9 femmes enceintes, recevant

du sulfate de magnésium par voie intraveineuse afin de prévenir une menace d'accouchement prématuré. Une demi-heure après l'administration de sulfate de magnésium, la magnésémie moyenne ( $\pm$  E.T.) a significativement augmenté et est restée significativement élevée après 1, 2 et 3 heures. Malgré l'hypocalcémie, les concentrations de parathormone (PTH) ont diminué rapidement pendant une demi-heure, restant à un taux inférieur aux valeurs initiales pendant 2 heures. Par rapport à leur valeur initiale, les concentrations sériques de calcium total et ionisé ont toutes deux chuté après 3 heures. Nos résultats suggèrent que l'hypermagnésémie diminue la sécrétion de parathormone chez la femme enceinte; cette inhibition persistant malgré une hypocalcémie concomitante. De plus, ces résultats démontrent que l'hypocalcémie associée à l'hypermagnésémie peut être engendrée par l'inhibition de la parathormone sérique. Seules ont été étudiées les femmes enceintes présentant une toxémie gravidique pure.

### Introduction

It has been shown that during normal pregnancy serum magnesium decreases [1]. In recent years the use of magnesium salt for different pathological pregnancy conditions like for the suppression of premature labor [1, 6, 10, 14, 28, 24] is now generally accepted. Also it is established that calcium serves as a principal regulator of the parathyroid gland function [3, 16]. Hypomagnesium has been found to inhibit the parathyroid hormone secretion and also interferes with its peripheral actions [11, 23]. In regard to overall

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regulations of parathyroid hormone secretions, magnesium appears to be similar to calcium [15] with a potency of 0.3 to 0.5 in respect to calcium [4, 12, 27]. Previous studies on the effect of hypermagnesemia on parathyroid gland function and serum calcium levels are not conclusive [2, 7, 23].

Treatment of toxemia (EPH-Gestosis) and premature labor with magnesium sulfate leads to elevated serum magnesium [13, 22, 25].

This study describes the changes in serum parathyroid hormone after administration of magnesium sulfate for suppression of premature labor and also the relationship between serum magnesium and serum calcium.

## Methods and Materials

N = 9 III. trimester normal pregnant women (mean age  $\pm$  SD  $25.4 \pm 7.2$  years gestational age  $29.5 \pm 3.3$  years) were treated with intravenous magnesium sulfate to suppress premature labor before 36 gestational weeks. 6 g of magnesium sulfate was given intravenous for 30 minutes followed by a maintenance intravenous infusion of magnesium sulfate at a speed of 2 g per hour.

Prior to magnesium sulfate infusion, blood samples were drawn and at 30, 60, 120, 180 minutes after. Serum magnesium and calcium concentrations were measured using atomic absorption spectrophotometry. Ionized calcium level were determined within 30 minutes after collection using the NOVA II ionized calcium analyzer. Parathyroid hormone levels were determined by radio-immunoassay (RIA).

Routine statistical analysis using Student-t-test & Wilcoxon test were used. Data are expressed as mean  $\pm$  SD (standard deviation).

Tab. 1.: Effect of 6 g MgSO<sub>4</sub> IV for 30 min. and continuous 2 g/hr Infusion on serum Magnesium, Calcium and PTH (n=9)

Time (minutes)	Serum Mg mmol/l	Serum total Ca mg/dl	Serum ionized Ca mg/dl	PTH pg/ml
0	0,84 $\pm$ 0,15	8,7 $\pm$ 0,2	4,3 $\pm$ 0,16	12,8 $\pm$ 2,7
30	2,6 $\pm$ 0,18	8,6 $\pm$ 0,21	4,1 $\pm$ 0,09	7,6 $\pm$ 0,9*
60	5,2 $\pm$ 0,13*	8,1 $\pm$ 0,8*	4,2 $\pm$ 0,09*	8,1 $\pm$ 1,4*
120	4,9 $\pm$ 0,11*	7,6 $\pm$ 0,9*	3,9 $\pm$ 0,08*	10,3 $\pm$ 3,1*
180	5,0 $\pm$ 0,12*	7,5 $\pm$ 0,8*	3,7 $\pm$ 0,12*	12,4 $\pm$ 2,6

\* p < 0,001

## Results

In Table 1 magnesium sulfate administration over 30 minutes the mean ( $\pm$  SD) (0.84  $\pm$  0.15) serum magnesium level rose significantly after 30 minutes to mean  $\pm$  SD (2.6  $\pm$  0.18 mmol/l p < 0.001).

Continuous magnesium sulfate infusion at 2 g/hr kept the serum magnesium level significantly high after 1, 2 and 3 hours (p < 0.001).

The serum level of parathyroid hormone fell rapidly during 1/2 hour, remaining significantly below the base line for 2 hours despite hypocalcemic state (Table I) (12.8  $\pm$  2.7 / 10.3  $\pm$  3.1 pg/ml p < 0.001).

Both total calcium and ionized calcium level (8.7  $\pm$  0.2 mg/dl / 4.3  $\pm$  0.16 mg/dl) dropped significantly after 1 hour (8.1  $\pm$  0.8 / 4.0  $\pm$  0.09 mg/dl) and after 3 hours respectively (7.5  $\pm$  0.8 / 3.7  $\pm$  0.12 mg/dl) p < 0.001).

## Discussion

Our result shows a sharp reduction in serum parathyroid hormone level during hypermagnesemia, which was also accompanied by reduction in serum concentration of both ionized and total serum calcium. These findings are in agreement to that of other authors [7, 9, 19, 21]. Under the prolonged hypocalcemia, the parathyroid hormone levels

moved towards the base line levels demonstrating independent effects on the secretion of parathyroid hormone thus supports other reports [2, 17, 20, 26].

There are controversy on the effect of hypermagnesemia on parathyroid hormone level. Cruikshank, 1979 [7] demonstrated slightly increase or according to Donovan et al. 1980 [9] no change in the level of parathyroid hormone. The hypocalcemic state shown in our study was the result of magnesium related suppression of parathyroid hormone secretion although other contributing factors may be possible. Carney et al. 1980 has shown that magnesium ions compete with calcium for reabsorption in the loop of Henle and Cruikshank et al. 1981 [5, 8] demonstrated that renal calcium loss may contribute to the development of hypercalcemia in patients with hypomagnesemia.

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