

# The Bronchodilating Effect of Inhaled Magnesium

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## Zusammenfassung

Bei 30 Asthmatikern mit einer diskreten bis mäßigen Bronchienreaktivität haben wir den bronchodilatatorischen Effekt der Inhalation von Magnesiumsulfat ( $MgSO_4$ ) untersucht. Die Patienten befanden sich nicht im Stadium der klinischen Remission, und ihr maximales Atemsekundenvolumen war um 80 % niedriger als vorgesehen. In randomisierter Reihenfolge bekamen sie an verschiedenen Tagen Inhalationen mit physiologischer Kochsalzlösung (NaCl) und Magnesiumsulfat ( $MgSO_4$ ). Während des Tests wurden an jedem Tag vor der Inhalation mit NaCl und  $MgSO_4$  und danach zehn Minuten die spirometrischen Parameter gemessen. Dabei wurde kein signifikanter bronchodilatatorischer Effekt von NaCl oder  $MgSO_4$  festgestellt.

## Summary

The bronchodilating effect of inhaled magnesium sulfate ( $MgSO_4$ ) was studied in 30 asthmatic patients with mild to moderate bronchial reactivity. The patients were not in clinical remission and had a forced expiratory volume at 1 second ( $FEV_1$ ) lower than 80 % of predicted. Subjects received, in random order, on separate days apart, saline (NaCl) and  $MgSO_4$  inhalation. Spirometry was recorded on each test day before and ten minutes after NaCl and  $MgSO_4$  inhalation. Neither NaCl nor  $MgSO_4$  was found to have a significant bronchodilating effect on spirometric measurements.

## Résumé

Nous avons étudié l'effet bronchodilatateur de l'inhalation de sulfate de magnésium ( $MgSO_4$ ) chez 30 patients asthmatiques présentant une réactivité bronchique discrète à modérée. Les patients n'étaient pas au stade de rémission clinique et leur volume expiratoire maximum par seconde (VEMS) était de 80 % inférieur à celui prévu. Ils ont reçu, selon un ordre randomisé et à des jours différents, des inhalations de sérum physiologique (NaCl) et de sulfate de magnésium ( $MgSO_4$ ). Chaque jour d'examen, on a enregistré les paramètres spirométriques avant et dix minutes après l'inhalation de NaCl et de  $MgSO_4$ . Les mesures spirométriques n'ont révélé aucun effet bronchodilatateur significatif du NaCl ou du  $MgSO_4$ .

## Introduction

Calcium ion acts as the intracellular messenger for stimulus-response coupling in many different cell types, most notably in reference to asthma, in smooth muscle cells of the bronchial tree, mediator releasing cells, mucus producing cells and parasympathetic nerve endings. The availability of calcium to the contractile or secretory apparatus of the cytosol represents the final common pathway for all influences upon the cells involved in the asthmatic diathesis. An increase in  $Ca^{+2}$  influx through bronchial smooth muscle cells may be the fundamental abnormality in asthma and might be an explanation for bronchial reactivity [3, 6].

Calcium antagonistic drugs have been shown to inhibit in vitro the synthesis of a variety of chemical mediators and to exert a significant protection against exercise, histamine and metacholine induced bronchoconstriction in asthmatics [4, 6]. Magnesium is a weak antagonist of calcium entry into smooth muscle cells and it influences the intracellular content and disposition of calcium [1, 5]. Consequently, the present study was designed to evaluate the effect of inhaled  $MgSO_4$  in bronchial asthma.

## Methods

We studied 30 non-smoking patients (18 males and 12 females), 24–36 years of age (mean  $26.8 \pm 5.4$ ), ten with atopic and twenty with intrinsic bronchial asthma. All of them were outpatients making routine visits to the Pulmonary Diseases Department of Medi-

cal Faculty of Istanbul University. They were diagnosed according to the American Thoracic Society's definitions of asthma [2]. All patients gave voluntary informed consent. They had mild to moderate bronchial reactivity. They exhibited neither cardiac nor renal dysfunction. The other exclusion criteria for the study included a  $FEV_1/FVC$  ratio less than 50%, fever, purulent sputum, infection and infiltrate on a chest roentgenogram. None of the subjects had respiratory tract infection for 6 weeks prior to the study. None was receiving cromolyn sodium, ketotifen or cortico-steroids. All patients had received maintenance therapy consisting of  $\beta_2$ -stimulants and theophylline derivatives. During the study (including 48 hours before the study) period subjects received only inhaled  $\beta_2$ -agonists and none of them were given any medication, including  $\beta_2$ -agonists, 12 hours before each test.

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Tab. 1: FVC and FEV<sub>1</sub> values before and 10 minutes after NaCl and MgSO<sub>4</sub> inhalation.

	Baseline	NaCl	Baseline	MgSO <sub>4</sub>
FVC (ml)	3430 ± 593	3436 ± 595	3450 ± 572	3432 ± 604
FEV <sub>1</sub> (ml)	2117 ± 375	2120 ± 379	2153 ± 360	2150 ± 363

No significant difference by analysis of variance

Subjects received, on separate days, 3 days apart, 5 ml of either NaCl or MgSO<sub>4</sub> (0.75 g/10 ml) from a deVilbiss 35B nebulizer. Lung function tests were recorded on each test day in basal conditions and 10 minutes after NaCl and MgSO<sub>4</sub> inhalation by use of a water-seal spirometer (Godart Expirograph). Measurements were repeated until three lung function tests varying no more than 5% were obtained in each subject. From these results the best FVC and FEV<sub>1</sub> were selected.

Data were expressed as mean ± SE. Comparisons among respiratory function test values of the two test days, before and after NaCl and MgSO<sub>4</sub> inhalation, were performed by analysis of variance. Statistical significance was taken to be p < 0.05.

After NaCl inhalation FVC and FEV<sub>1</sub> were improved by 1.38% ± 0.45 and 1.41% ± 0.32 respectively of their initial values. The improvement produced by MgSO<sub>4</sub> inhalation was 1.24% ± 0.28 and 1.19% ± 0.24 of the FVC and FEV<sub>1</sub> baseline values respectively. Consequently, no significant difference

was obtained, by analysis of variance, between the baseline values and NaCl or MgSO<sub>4</sub> inhalation values of pulmonary function (tab. 1).

### Discussion

In this study we wanted to evaluate the effects of inhaled magnesium in bronchial asthma. We demonstrated that MgSO<sub>4</sub>, administered by aerosol, did not have any beneficial effect in asthmatics with mild to moderate bronchial reactivity. Our findings do not support the results obtained by Rolla et al. In his studies Rolla concluded that MgSO<sub>4</sub>, administered by aerosol, effectively inhibited histamine and metacholine induced bronchoconstriction in asthmatics, with mild to moderate bronchial reactivity, who were in clinical remission [7, 8]. Our patients were not in clinical remission and had mild or moderate bronchial reactivity at the time of the study. Based on our findings we can conclude that inhaled MgSO<sub>4</sub> does not have any significant bronchodilator effect.

### References

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