

Therapeutic efficacy of intravenous magnesium sulphate for the treatment of acute asthma in the Emergency Department

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Abstract:

Background: Acute asthma management is based on rapid reversal of bronchospasm and reduced inflammatory mucosa of airway. The age old solution i.e. nebulization with β agonist therapy, is increasingly being with discouraging results in moderate to severe asthmatics. Since the “poor responders” comprise up to 30% of all acute asthmatics, the need for newer options is real.

Objective: To study the therapeutic efficacy of magnesium sulphate (intravenous) for the treatment of acute asthma in the emergency department.

Material and Methods: Sample of 100 patients taken for this study from 1st January 2020 till 31st December 2020. with acute exacerbation of asthma, this is a prospective cohort study. No any bias was noticed related to gender or age and the sample was collected using non-probability, consecutive sampling. Simple clinical assessment was done for the entire sample and oxygen saturation along with peak expiratory flow rate before and after the intervention were recorded in addition to basic biodata and socio-demographic details and disease particulars. The patients were randomly designated into two groups-A (Intravenous placebo infusion of normal saline) and B (Intravenous infusion of 1.2g magnesium sulphate) after conventional β agonist therapy failed to produce significant improvement in peak expiratory flow rate. The data was recorded in proforma and analyzed using SPSS v.21. & Microsoft Excel.

Results: 112-patients were enrolled, in this study males were 63.4% & 36.6% were females. The mean age is 44 years ($SD \pm 13.11$) and most (33.03%) of the patient were aged 56 and above. The group was taking treatment reveals an elevation in peak expiratory flow rate from 212 to 293 L/min in comparison with 202 to 219 L/min in the placebo group. In addition, The ratio was significantly improved in treatment group in comparison with placebo group in admitted vs discharged.

Conclusion: After careful consideration, it can be concluded that the intravenous magnesium-sulfate has high therapeutic efficacy when used in for acute episodes of moderate to severe asthma in patients that respond poorly to conventional nebulized β -agonist therapy.

Keywords: Acute Asthma, emergency medical care, peak expiratory volume, intravenous magnesium sulphate and β -agonist therapy.

Introduction:

The prevalence of asthma is rather high, with every 1 in adults 10 and every 1 in 3 children are suffering from this ailment around the world.¹ During the last decade, the prevalence of this condition has risen further and continues to move at a steep trajectory upwards, leading researchers to forecast a grim future both at a per-

sonal and societal level for all around the world.² Despite the fair warnings and the already dismal condition, efforts directed towards control of asthma remain rather poor and thus hope for them to yield any solid benefits is dismal.³

Acute bronchial asthma have been primarily manage in emergency with β adrenergic agents

Received

Date: 21st January, 2021

Accepted

Date: 27th June, 2021

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for 50 years & their effectiveness for most patients, as many as 30% of patients coming to emergency departments fail to respond adequately to β -agonists and suffer grim fates⁴ such as repeated hospital admissions,⁵ high morbidity and even mortality.⁶

Patients resistant to β -agonist therapy should receive corticosteroid therapy, but this often requires hours to demonstrate significant benefit. Other therapeutic agents that could improve air-flow obstruction early would be of great benefit. One drug that has been reported to successfully reverse bronchospasm in patients, refractory to β -agonists, is magnesium sulfate.⁷ Magnesium, is intracellular cation & it is a very predominant factor enzymatic reactions and it is related to cellular homeostasis. Additionally, magnesium has effect on smooth muscle hyper-magnesemia leads to relaxation & hypomagnesemia leads to smooth muscle cells contraction.⁸

In smooth muscle, magnesium decreases intracellular calcium by blocking its entry and its release from the endoplasmic reticulum and activating sodium-calcium pumps.⁹ Furthermore, inhibition of the interaction between calcium and myosin results in muscle cell relaxation.¹⁰ Magnesium also stabilizes T cells and inhibits mast cell degranulation, leading to a reduction in inflammatory mediators.¹¹ In cholinergic motor nerve terminals, magnesium depresses muscle fiber excitability by inhibiting acetylcholine release.¹² Lastly, magnesium stimulates nitric oxide and prostacyclin synthesis, which might reduce asthma severity.¹³ Thus, it's a reason to feel that intravenous magnesium sulfate treatment, may be advantageous in management of acute asthma.

Nearly 80 years ago, a research described 2-patients with acute asthma who were refractory to epinephrine hydrochloride injections but responded to intravenous and intramuscular magnesium.¹⁴ More recently, symptomatic improvement and improved peak expiratory flow rates (PEFR) in 5-patients with mild asthma who received 1.2 g of magnesium sulfate intravenously have been claimed¹⁵ but the research

yielded these claims is seldom blinded, and placebo controlled.

The purpose of this study was to evaluate the therapeutic efficacy of magnesium sulphate in the treatment of patients presenting to an emergency department with moderate to severe asthma using a randomized, placebo-controlled protocol.

Material and Methods:

Sample of 100 patients taken for this study with acute exacerbation of asthma, this is a prospective cohort study. All patients meet the diagnostic criteria for asthma as per American Thoracic Society, New York. No any bias was noticed related to gender or age and the sample was collected using non-probability, consecutive sampling. Simple clinical assessment was done for the entire sample and oxygen saturation along with peak expiratory flow rate before and after the intervention were recorded in addition to basic bio-data and socio-demographic details and disease particulars. The patients were randomly designated into two groups A (Intravenous placebo infusion of normal saline) and B (Intravenous infusion of 1.2g magnesium sulphate) after conventional β -agonist therapy failed to produce significant improvement in peak expiratory flow rate.

A single infusion rate was used to standardize therapy for each patient. After initial nebulization from 45 to 60 minutes, a second nebulization done. After 15 minutes PEFR was repeated. If this PEFR was double the initial PEFR, the patient was believed to adequately respond to β -agonists and excluded from the study. Those patients were considered poor responder whom PEFR were not doubled considered poor responders and eligible for the study. Written consent was then obtained, and each patient received infusion of a saline 50 mL as placebo or 1.2gm magnesium sulfate in 50 mL of saline infusion. The placebo/ magnesium solutions were pre-packaged in identical vials by the pharmacy and coded from a randomized list. The infusion was administered over 20 minutes. The data were recorded in design proforma and analyzed

Table:

Age group (years)	Male	Female	Total
Up to 25	11(9.82%)	2(1.79%)	13(11.61%)
26 to 35	9(8.04%)	5(4.46%)	14(12.5%)
36 to 45	13(11.6%)	7(6.25%)	20(17.86%)
46 to 55	17(15.2%)	11(9.8%)	28(25%)
56 and above	21(18.75%)	16(15.72%)	37(33.03%)

Table:

Variable	Group A		Group B	
	Pre-Intervention	Post-Intervention	Pre-Intervention	Post-Intervention
PEFR (L/min)	202	219	212	293
Effect	17 L/min (8.42%)		81 L/min (38.2%)	

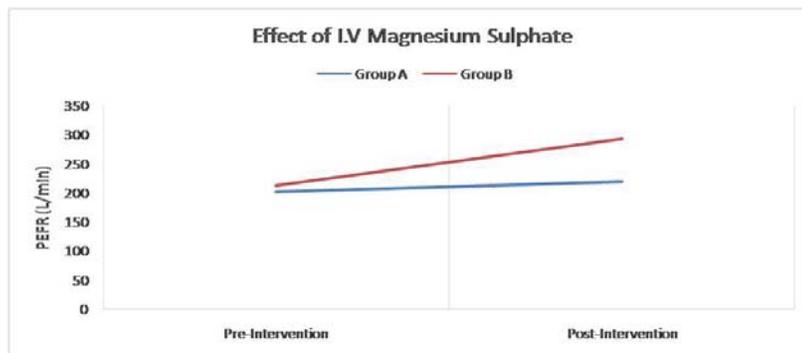


Table :

Variable	Group A	Group B
Admitted	23	11
Discharged	27	39

using SPSS v.21 & Microsoft Excel.

Exclusion criteria for the study included rectal temperature of greater than 38°C, systolic blood pressure less than 120 mmHg, a history of kidney disease, purulent sputum, infiltrate on a chest roentgenogram, and pregnancy.

Results:

112 patients were enrolled, in this study from 1st January 2020 till 31st December 2020. 63.4% were males & 36.6% were females. The mean age is 44 years (SD±13.11) and most (33.03%) of the subjects were aged 56 and above.

The group was taking treatment reveals an elevation in peak expiratory flow rate from 212 to 293 L/min in comparison with 202 to 219 L/min in the placebo group.

The ratio was significantly improved in treatment group in comparison with placebo group in admitted vs discharged.

Discussion:

Our sample showed a predominance of elderly males presenting with acute exacerbation of asthma. This synonymous with literature which shows that episodes of asthma become more severe with age, and with increasing age, the body’s ability to handle acute exacerbations diminishes, and even milder acute attacks meriting emergency room visits and hospital admissions.¹⁶

A variety of therapeutic agents are employed upon visiting the hospital, and as of late, magnesium sulphate is becoming a mainstay, with some administering in via the inhalational route to achieve a faster onset of action and quicker relief to the patient, however it comes at a cost. Large doses cannot be administered and patients presenting with more severe episodes often do not find much relief upon inhalational administration. While other resorting to intravenous administration to administer larger doses and achieve more stable results but often leading to morbidity and mortality owing to slower onset of action especially in exacerbations of very acute nature that merit very fast relief.^{16,17}

Research clearly shows that magnesium sulphate administration, regardless of what route in used, brings significant benefit to the patients and is recommended. However, much debate can be done on which route of administration is ideal. Each has its own advantages and disadvantages, but our research employs the intravenous route and its therapeutic efficacy is admirable. This is evident from all of the variables studied.¹⁸

In a similar research, intravenous administration of magnesium sulphate yielded better results in terms of improved peak expiratory flow rate

within 90 minutes than inhalational administration of magnesium sulphate. Additionally, intravenous administration of magnesium sulphate reduced the mean number of minutes that patients had to struggle with the exacerbatory episode of asthma. Furthermore, it reduced the overall mean hospital stay required after each episode of asthma.¹⁹ The study however lacked a prospective element so no follow-up could be carried out to determine the long term efficacy in terms of acute exacerbatory episodes in the immediate future and need for re-hospitalization.

Conclusion:

After careful consideration, it can be concluded that the intravenous magnesium sulfate has high therapeutic efficacy when used in for acute episodes of moderate to severe asthma in patients that respond poorly to conventional nebulized β -agonist therapy.

Conflict of interest: none

Funding source: none

Role and contribution of authors:

Wajahat Ali, conceived, concept design and definition of intellectual content, literature search, data acquisition.

Shua Nasir, did literature search and manuscript preparation did final layout and data entry.

Lal Shahbaz, did write up, manuscript preparation, final layout.

Mohammed Aqil, data entry & final layout.

Syed Jehanzeb Asim, literature search & data entry.

Abdul Samad, data entry & final layout.

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