ORIGINAL ARTICLE

COMPARISON OF THE EFFECTS OF INTRAVENOUS MAGNESIUM SULPHATE VERSUS INTRAVENOUS AMINOPHYLLINE IN ACUTE ATTACK OF ASTHMA

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ABSTRACT:

Background: In children acute severe asthma is a serious condition. Intravenous aminophylline is being used in the management of acute attack of asthma since long Magnesium sulphate IV helps in asthma management because it is a mild bronchodilator, and has the potential to stabilize acute attack of asthma.

Objective: To compare the effectiveness of intravenous magnesium sulphate versus intravenous aminophylline in acute attack of asthma.

Methods: It was a randomized control trial from April 2017 to October 2017 at Emergency Department of pediatric Lahore General Hospital Lahore. 60 cases were included in the study. They were randomly divided in two comparable groups. Children in group A ware treated with intravenous magnesium sulphate and group B with intravenous aminophylline. The efficacy of the drug was judged by the improvement in the sign observed like respiratory rate (less than 40 per minute), pulse rate (<100), oxygen saturation (above 90 %) assessed after the time period of three hours.

Results: The improvement after intravenous magnesium sulphate in severe attack of asthma was found in 28 cases in Group A (93.33%) and in 22 cases in Group B (73.33%) treated with intravenous aminophylline (p-value 0.03). However, 6.67% cases (2 cases) in Group A and 26.67% cases (8 cases) in Group B did not show effectiveness.

Conclusion: The clinical efficacy of intravenous magnesium sulphate in managing case of acute severe asthma was better when compared with intravenous aminophylline.

Keywords: Children, asthma, magnesium sulphate, aminophylline, effectiveness

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INTRODUCTION

Asthma is a common chronic airways problem of children and they comprise 7-10% of the population. It is basically inflammation of the airways resulting in bronchospasm of the lungs. Before puberty it's common in boys. A genetic predisposition to asthma is recognized.[1, 2] In 2001 to 2003 it was the leading cause of hospitalization in UK and accounted for more than 1.8million hospital visits. The overall deaths were 4210/year.[2] Magnesium sulfate has been widely used in anesthesia, Obstetrics and Intensive care unit. It is considered a combination therapy for severe asthma exacerbations.[3]It is postulated to interfere physiological action of calcium resulting in decreased bronchial smooth muscle contraction. Magnesium sulfate also decreases inflammatory process of airways by interfering with mast cell degranulation.[4]

Another research was done by Sunit C Singhi et al on 100 children with acute severe asthma aged 1-12 years. They found that the magnesium sulphate group

had higher therapeutic efficacy (97%) than the terbutaline and aminophylline groups (70%). They also observed that use of magnesium sulfate resulted in earlier relief of bronchospasm.[5]

Methylxanthines have been used in the cure of asthma for more over 50 years. Aminophylline is a soluble salt, has many actions in controlling asthma through smooth muscle relaxation, improved chest strength, anti-inflammatory effect, diuretic effect and increased mucociliary effect.[6] Young M. et al studied 163 children with acute severe asthma. There was improvement in symptoms and pulmonary function in group receiving IV aminophylline (48/81, 59%) as compared to placebo group (20/82, 24 %).[7]Recently, aminophylline has been hailed by UK pediatricians as the first line of line of respiratory tract.8

As severe attack of asthma has been one of the most frequent reasons for attending pediatric emergency section in our country, so this study was carried out to identify the effectiveness of IV Magnesium sulfate to bring more rapid relief in acute attack of asthma and also help to decrease the number of patients requiring subsequent mechanical ventilation in the background of limited ventilatory facilities.

METHODS:

It was randomized control trial conducted in the emergency room of pediatric department of Lahore General Hospital Lahore, from April 2017 to October 2017. Approval of the research protocol was obtained from hospital ethics committee before the beginning of the present study. All sex children, ages 3-16 present to the emergency department with a severe asthma attack that responds inadequately to normal nebulization with the three amounts of β2-adrenergic agents included in the study. Patients who needed immediate tracheal intubation, had used these drugs in the past hours were not included. Informed consent was taken from guardian of patients and demographic profile was recorded including age, gender and address. All data was recorded on structured proforma. Patients were occasionally divided into two groups by lottery method (30 patients in each group). Children in group A were treated with IV magnesium sulphate with a (50-70 mg/kg/dose given in 30 minutes) and cases in group B were treated with IV aminophylline (5mg/kg/dose given in 30 minutes). Following parameters were observed in both groups during the treatment for effectiveness of therapy including respiratory rate, Pulse rate, and oxygen saturation. End point of study was end of 3hours (180mint) period of observation and examination of the study population.

Data were analyzed using the SPSS version 18. All quantitative variables were analyzed like age and hospital stay as mean and standard deviation. Frequency and percentage of qualitative variables like gender was calculated. Data was stratified for age and gender. Both groups were compared for respiratory rate, O2 saturation at presentation with chi-square test with post stratification. p-value < 0.05 was considered as significant.

RESULTS:

A total of 60 cases (30 in each group) fulfilling the inclusion/exclusion criteria were enrolled to compare the effectiveness of IV magnesium sulphate versus IV aminophylline in acute attack of asthma.

The mean age of study cases was 8.1+3.09 years in Group A and 7.7+3.33 years in Group B. Regarding age distribution, 80 % cases (n=24) in Group A and 76.67 % cases (n=23) in Group B were in age 3-10 years, whereas 20 % cases (n=6) in Group A and 23.33 % cases (n=7) in Group B were in age range of 11-16 years. (Table 1). Regarding gender distribution, male children were 46.67% (n=16) in Group A and 53.33% (n=14) in Group B. Whereas 53.33% (n=14) in Group (A) and 46.67% (n=16) in Group (B) were female children. (Table No. 2). Mean hospital stay in Group (A) was 2.63+0.61 days and 3.0+0.74 days in Group (B). (Table No. 3)

On comparing the effectiveness of IV magnesium sulphate versus IV aminophylline in acute attack of asthma, 93.33% (n=28) in Group (A) and 73.33% (n=22) in Group (B) had effective whereas remaining 6.67% (n=2) in Group (A) and 26.67% (n=8) in Group (B) had no effect, p value was 0.03 showing a significant difference. (Table No. 4)

The data was analyzed for age and sex with chi-square test with p-value < 0.05 considered as significant. (Table No. 5-6)

Mean respiratory rate ± SD was 21.6 ± 2.46 breaths / minute in patients treated by aminophylline and 17.8 ± 1.55 breaths / minute in the magnesium group showing significant difference (p-value 0.36).Pulse rate in the baseline of two groups was also significantly different with mean ± SD value of 106.2 ± 8.34 beats / minutes and 100.1 ± 7.43 beats / minute in aminophylline and magnesium groups respectively. Mean arterial pressure ± SD was 97.8 ± 2.60 mmHg in patients treated by aminophylline and 94.5 ± 1.67 mmHg in the magnesium group showing significant difference (p-value <0.05)

Similarly oxygen saturation significantly improved (p value 0.004) after 180 minutes of treatment, having mean ± SD value of 95.2 ± 1.20 % in the aminophylline

and 96.2 ±1.51% in the magnesium group. Borg dyspnea scale is a rating from 0 through 10 that allows patients to self-assess breathlessness, where 0 indicates no dyspnea and 10 represents the most severe dyspnea. Borg Dyspnea score was 9.6 on arrival in ED in both groups. There was significant decrease (P<0.05) in Borg scale after 180min of treatment in magnesium treated group as compared to aminophylline.(Table No.7)

Table 1: Age Distribution (n=60)

Age (in years)	Group(A)(n=30) Magnesium Sulphate		Group(B) (n=30) Aminophylline	
	No. of patients	%	No. of patients	%
3-10	24	80	23	76.67
11-16	6	20	7	23.33
Total	30	100	30	100
Mean+SD	8.1+3.09		7.7+3.33	

Table 2: Sex Distribution (n=60)

Sex	Group(A) (n=30)		Group(B) (n=30)	
	No. of patients	%	No. of patients	%
Male	16	46.67	14	53.33
Female	14	53.33	16	46.67
Total	30	100	30	100

Table 3: Distribution of patients by Mean Hospital Stay (n=60)

Hospital stay	Group(A) (n=30)		Group(B) (n=30)	
	Mean	SD	Mean	SD
	2.63	0.61	3.0	0.74

Table 4: Comparison of effectiveness of intravenous Magnesium Sulphate versus Intravenous Aminophylline in acute attack of asthma (n=60)

Sex	Group(A) (n=30)		Group(B) (n=30)	
	No. of patients	%	No. of patients	%
Yes	28	93.33	22	73.33
No	2	6.67	8	26.67
Total	30	100	30	100

Table 5: Stratification for effectiveness of intravenous Magnesium Sulphate versus Intravenous Aminophylline in Acute attack of asthma with regards to age (n=60)

Group	Efficacy		P value
	Yes	No	
AGE: 3-10 years			
A	22	2	0.10
B	17	6	
AGE: 11-16 years			
A	6	0	0.15
B	5	2	

Table 6: Stratification for effectiveness of intravenous Magnesium Sulphate versus Intravenous Aminophylline in acute attack of asthma with regards to Sex (n=60).

Group	Efficacy		P value
	Yes	No	
Male			
A	15	1	0.04
B	9	5	
Female			
A	13	1	0.35
B	13	3	

Table 7. Clinical Measures According to Study Group on Emergency Room Arrival, and 180 min after Arrival.

Topics	0 minute (Arrival)		180 minute (after Arrival)		Mean difference between groups
Variables	Aminophylline	Magnesium	Aminophylline	Magnesium	(95% C.I.)
Respiratory Breaths/ minute	38.70(3.40)	38.20(2.56)	21.60(2.46)	17.83(1.55)	3.77(2.32– 0.85)
Pulse rate/minute	126.47(11.47)	127.97(10.19)	106.27(8.34)	100.10(7.43)	6.17(0.24-15.29)*
Mean Pressure mm Hg	104.5(5.28)	103.17(16.48)	97.83(2.60)	94.5(1.67)	3.33 (0.15 – 4.02)
Oxygen saturation	94.2 ± 1.81	93.7 ± 2.23	95.2 ± 1.20	96.2 ± 1.51	01(0.03-1.02)
Borg Dyspnea Scale	9.66(0.484)	9.67(0.50)	4.40(1.35)	2(0.83)	2.4 (0.2 – 1.0)

Data is presented as idle (SD) unless otherwise indicated. The incidence of Borg dyspnea was reduced from 0 (no symptoms) to 10 (severe symptoms) Aminophylline or magnesium was given immediately after a 30-min test. Magnesium was treated 50-70 mg/kg/dose IV. (* p <0.05,** p<0.01)

DISCUSSION

In children the most severe asthma is a serious condition that requires careful management in selected cases. The inhaler route of drug delivery is not suitable when changing only small volumes of respiration; i.v. the route can be associated with more serious consequences. To avoid side effects of salbutamol i.v Magnesium sulphate medication you can choose to treat acute astma.it is a mild bronchodilator and has the ability to stabilize atria.

In our study, we measured the effectiveness of IV Magnesium Sulphate compared to IV aminophylline in severe asthma attacks. As asthma is one of the most common problems in the emergency department in our country so this study helps us to identify the drug in the immediate action of asthma and also helps to reduce the number of patients who then needed a small amount of fresh air in our country with limited ventilation.[10]

In this study, out of 30 cases, 46.67% (n=16) in Group (A) and 53.33% (n=14) in Group (B) were male whereas 53.33% (n=14) in Group (A) and 46.67% (n=16) in Group (B) were females, mean age was calculated as 8.1+3.09 years in Group (A) and 7.7+3.33 years in Group (B), comparison of effectiveness of intravenous magnesium sulphate versus intravenous aminophylline in acute attack of asthma shows that 93.33% (n=28) in Group (A) and 73.33% (n=22) in Group (B) had efficacy, p value was 0.03 showing a significant difference.

We compared our results with Young M. et al who performed randomized study in 163 children. There was improvement in symptoms and pulmonary function in a group that was given intravenous aminophylline (48/81, 59%) as compared to placebo group (20/82, 24%).[7,11]

Another research was done by Sunit C Singhi in hundred children. All the children were of age 1-12years. They recognized 97% successful rate of magnesium sulphate as compared to aminophylline and terbutaline i.e.70% in the management for acute severe asthma. They were also observed that magnesium sulfate has fast reliever of sign and symptoms.[5, 12]

Jose Enrique Irazuzta and others described that the therapeutic efficacy of magnesium sulfate for severe asthma in emergency department have huge variability.[13]They recognized that pharmacokinetics of magnesium sulfate were not considered with a consequent impact in its pharmacodynamics. However it is concluded that the early administration of magnesium sulfate with adequate dose that is 50-75mg/kg decline hospital admission of severe asthma. Although use of high dose continuous magnesium sulfate infusion (200 mg/kg/4 h) is more effective as compared to conventional dose. They observed that one out of five hospital admissions were prevented with MgSO4. Moreover, magnesium sulfate was safe and had less side effects as compared to others ant-asthmatic drugs.

Experts recommend magnesium sulphate as a link therapy, while Beta agonist and corticosteroids remain key drugs in the treatment of severe asthma.[13]

Another research done by Schiermeyer and Finkelstein showed that magnesium sulfate was more effective in the management of acute asthma.[14] Similarly Pabon et al stated that magnesium sulfate was more effective as compared to conventional treatment[15] in ventilated patients. High dose magnesium sulfate was considered as the drug of choice for ventilated patients to decline peak air way pressure.[16]

In view of the above facts, magnesium sulfate has been shown to be an effective treatment for acute asthma. The results of our study concluded that there was a significant difference in the effect of IV magnesium sulfate compared to IV aminophylline in acute asthma attacks.

CONCLUSION:

We concluded that the effect of IV Magnesium Sulphate is significantly better when compared with IV aminophylline in acute attack of asthma.

ETHICAL APPROVAL

The study was approved from Ethical Review Committee of Postgraduate Medical Institute, Lahore, Pakistan, vide reference No, AMC/PGMI/LGH/Article/ Research No./00-181-20, dated December 23, 2020

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AUTHORS' CONTRIBUTION:

AZ: Concept, study design, Manuscript writing
HH: Material and methods
MA, FH: Data collection
RG: Data analysis
ASA: Results, Review