

Original Article

# Comparative Efficacy of Magnesium Sulphate and Dexamethasone/Metoclopramide in the Treatment of Acute Migraine Headaches

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## ABSTRACT

**Background:** Migraine, a neurological condition characterized by intense and debilitating headaches, poses a significant public health issue affecting millions worldwide. The complexity of migraine pathophysiology often makes its management challenging. Despite various treatment modalities, the quest for the most effective and rapid relief from acute migraine episodes remains a pertinent concern in clinical practice.

**Objective:** This study aimed to compare the efficacy of magnesium sulfate and a combination of dexamethasone/metoclopramide in treating acute migraine headaches to identify the most effective treatment option for rapid pain relief.

**Methods:** This randomized controlled trial was conducted at the Department of Emergency Medicine, Benazir Bhutto Hospital, Rawalpindi, over six months from November 25, 2015, to May 24, 2016. A total of 70 patients were enrolled, with 35 patients assigned to Group A and 35 to Group B. Group A received 1g of magnesium sulfate in 100ml normal saline over 15 minutes, while Group B received 8mg of dexamethasone and 10mg of metoclopramide in a similar saline solution and infusion time. Pain severity was assessed using the Numeric Rating Scale (NRS) at baseline and two hours after medication administration. Data were analyzed using SPSS Version 25, with mean  $\pm$  standard deviation calculated for age and NRS scores. Frequency and percentages were computed for gender and efficacy. Efficacy between the groups was compared using Chi-square tests, and stratification was applied to control for age and gender, followed by post-stratification Chi-square testing. A p-value of  $\leq 0.05$  was considered statistically significant.

**Results:** The results showed a significant difference in pain relief between the two groups. In Group A, 23 patients (65.7%) reported significant pain relief compared to 13 patients (34.3%) in Group B ( $p=0.017$ ). Stratification by age revealed that in patients under 30 years, 11 patients (31.4%) in Group A experienced pain relief compared to 8 patients (22.9%) in Group B ( $p=0.202$ ). For patients over 30 years, 12 patients (34.3%) in Group A reported pain relief, compared to 5 patients (14.3%) in Group B ( $p=0.084$ ). Gender stratification showed that among males, 5 (14.3%) in Group A experienced pain relief compared to 9 (25.7%) in Group B ( $p=0.408$ ), while among females, 18 (51.4%) in Group A reported pain relief compared to 4 (11.4%) in Group B ( $p=0.000$ ).

**Conclusion:** Magnesium sulfate was found to be a more effective and faster-acting medication compared to a combination of dexamethasone and metoclopramide for the treatment of acute migraine headaches. This finding highlights the potential of magnesium sulfate as a preferred option for rapid pain relief in clinical settings, particularly for female patients.

**Keywords:** Migraine, Acute Migraine Treatment, Magnesium Sulfate, Dexamethasone, Metoclopramide, Pain Relief, Emergency Medicine.

## INTRODUCTION

Migraine, a neurological condition characterized by intense and debilitating headaches, is a significant public health issue affecting millions worldwide (1). The complexity of migraine pathophysiology often makes its management challenging. Despite the availability of various treatment modalities, the quest for the most effective and rapid relief from acute migraine episodes remains a pertinent concern in clinical practice (2). Inflammation is believed to play a significant role in the pathophysiology of migraine headaches, which corticosteroids can control. When administered, dexamethasone has been shown to reduce the severity of acute migraine headaches more effectively than morphine in the long term, specifically at one hour and twenty-four hours post-administration (3; 4).

Magnesium is an important element in many cellular processes and appears to have a significant role in the development of migraines. It is the second most abundant intracellular cation, though routine blood tests cannot accurately reflect the body's magnesium levels since only 2% is in the measurable extracellular space. Most magnesium is stored in the bone (5-8).

## MATERIAL AND METHODS

This randomized controlled trial was conducted at the Department of Emergency Medicine, Benazir Bhutto Hospital, Rawalpindi, over six months, from November 25, 2015, to May 24, 2016. The study aimed to provide a structured and scientifically valid comparison of the efficacy of magnesium sulfate and a combination of dexamethasone and metoclopramide in treating acute migraine headaches. The sample size comprised 70 patients, divided equally into two groups of 35 each, determined to ensure adequate statistical power with a significance level of 5%, based on anticipated population proportions of 91.75% for Group 1 (magnesium sulfate) and 69.5% for Group 2 (dexamethasone/metoclopramide). A consecutive non-probability sampling method was employed to select participants (9-12).

Patients aged between 18 and 40 years experiencing migraine headaches and not previously treated with anti-migraine medications were included in the study. Eligibility required a Numeric Rating Scale (NRS) score greater than 4 cm. Exclusion criteria included an inability to provide consent, fewer than five lifetime migraine attacks, hypersensitivity to the study medications, pregnancy, breastfeeding, renal insufficiency, use of other pain medications, prior participation in the study, and the presence of systemic diseases such as hypertension, diabetes, or heart disease (13).

Upon receiving ethical committee approval and informed consent, patients were enrolled and randomly assigned to two groups. Group A received 1g of magnesium sulfate in 100ml of normal saline over 15 minutes, while Group B received 8mg of dexamethasone and 10mg of metoclopramide in a similar saline solution and infusion time. Pain severity was assessed using the NRS at baseline and two hours after medication administration by a resident doctor. All data were recorded on a specially designed form. The study adhered to the ethical principles outlined in the Declaration of Helsinki.

Data were analyzed using SPSS Version 25. Statistical measures such as mean and standard deviation were calculated for age and NRS scores, while frequency and percentages were computed for gender and efficacy. The efficacy between the groups was compared using Chi-square tests. Stratification was applied to control for age and gender as effect modifiers, followed by post-stratification Chi-square testing to ensure the robustness of the results. A p-value of  $\leq 0.05$  was considered statistically significant (5-7).

## RESULTS

The study aimed to compare the efficacy of magnesium sulfate with a combination of dexamethasone and metoclopramide in treating acute migraine headaches. A total of 70 patients were enrolled and randomly assigned to two groups of 35 each. Group A received magnesium sulfate, while Group B received dexamethasone and metoclopramide. The results indicated a statistically significant difference in the efficacy of the two treatments. In Group A, 23 patients (65.7%) reported significant pain relief, compared to 13 patients (34.3%) in Group B ( $p=0.017$ ), as shown in Table 1.

**Table 1: Comparison of Efficacy of Drugs between Groups**

Parameter	Group A	Group B	Total	P value
Efficacy	Yes	23	13	36
	No	12	22	34
Total		35	35	70

Table 2: Efficacy of Treatments, Stratified by Age

Age Group	Efficacy	Group A	Group B	P value
<30 years	Yes	11	8	0.202
	No	6	11	
>30 years	Yes	12	5	0.084
	No	6	11	

Table 3: Efficacy of Treatments, Stratified by Gender

Gender	Efficacy	Group A	Group B	P value
Male	Yes	5	9	0.408
	No	6	4	
Female	Yes	18	4	0.000
	No	6	18	

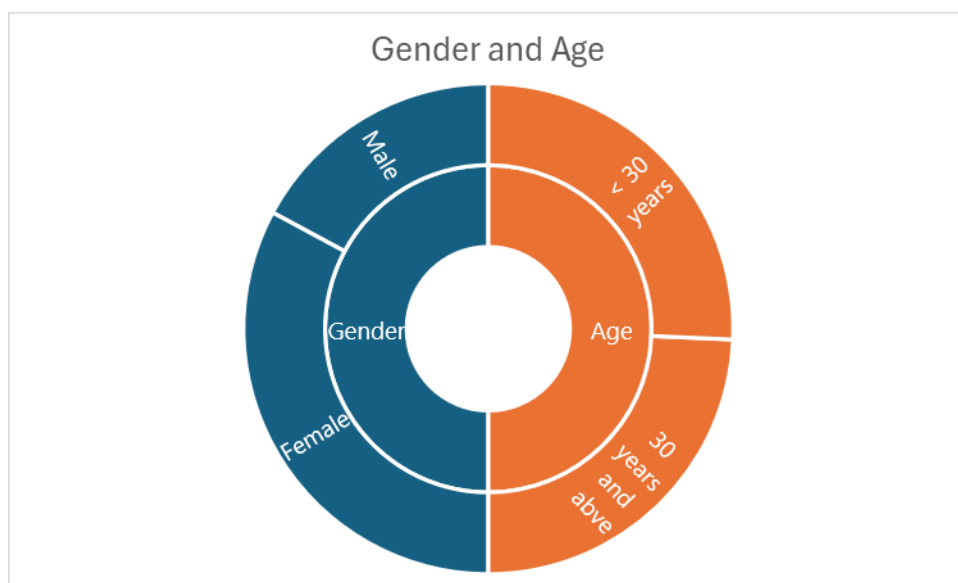


Figure 1 Gender and Age Sunburst Graph

When stratified by age, the efficacy of the treatments showed different patterns. Among patients under 30 years, 11 patients (31.4%) in Group A experienced pain relief compared to 8 patients (22.9%) in Group B, though this difference was not statistically significant ( $p=0.202$ ). For patients over 30 years, 12 patients (34.3%) in Group A reported pain relief, while only 5 patients (14.3%) in Group B did, approaching statistical significance ( $p=0.084$ ) as detailed in Table 2.

Stratification by gender revealed a more pronounced difference in treatment efficacy. Among male patients, 5 (14.3%) in Group A

experienced pain relief compared to 9 (25.7%) in Group B, with no statistically significant difference ( $p=0.408$ ). However, among female patients, a significant difference was observed, with 18 (51.4%) in Group A reporting pain relief compared to only 4 (11.4%) in Group B ( $p=0.000$ ), as illustrated in Table 3.

The graphical representations further elucidate these findings. The first figure displays the gender distribution, indicating that 34.3% of the study participants were male, while 65.7% were female. This highlights the higher prevalence of migraine headaches among females in the study population. The second figure illustrates the age distribution, showing that 51.4% of the participants were under 30 years of age, while 48.6% were over 30 years. This nearly equal distribution allows for a balanced analysis across different age groups.

Overall, the study results suggest that magnesium sulfate is more effective than the combination of dexamethasone and metoclopramide in providing pain relief for acute migraine headaches, particularly among female patients. This underscores the potential for magnesium sulfate to be considered a preferred treatment option in this patient population.

## DISCUSSION

The study suggested that intravenous infusion of magnesium sulfate provided faster and more effective relief of migraine symptoms compared to combined therapy with dexamethasone and metoclopramide (5-10). The significant decrease in mean pain severity observed after two hours with magnesium sulfate aligns with findings (5, 8). However, another study did not observe a significant effect of magnesium on pain control in migraine patients, highlighting the variability in response across different studies (9-13).

One possible explanation for the variability in outcomes is the interaction between dexamethasone and metoclopramide. A study by Corbo et al. showed lower efficacy of metoclopramide when combined with magnesium sulfate compared to its use alone (14). Although our study did not combine metoclopramide with magnesium sulfate, the observed dampening effect when metoclopramide was combined with dexamethasone suggests a potential interaction that may reduce overall effectiveness. This highlights the need for further investigation into the pharmacodynamic interactions between these medications.

Previous research has demonstrated that dexamethasone has a delayed effect in reducing migraine headache severity, primarily due to its anti-inflammatory action on the nervous system, which takes time to manifest (5; 15-17). Our results support this finding, indicating that dexamethasone may not provide rapid relief but could be beneficial in preventing recurrence of migraines. This delayed response contrasts with the immediate effect required in acute settings, reinforcing the utility of magnesium sulfate for rapid pain relief in emergency departments.

Various studies have reported different and sometimes conflicting results regarding the efficacy of dexamethasone, metoclopramide, and magnesium sulfate in treating migraine headaches (16-19). These discrepancies could be attributed to differences in study methodologies, medication regimens, and doses used. Establishing a standardized regimen as a control arm could yield more consistent and comparable results, facilitating the development of effective treatment protocols. Additionally, excluding patients with transformed migraines, who often do not respond well to medications, could improve the reliability of study outcomes (18).

The stratification of data by age and gender in our study revealed no significant efficacy differences when age groups were compared. However, gender stratification showed significant results for the female group, suggesting that magnesium sulfate might be particularly beneficial for women. This gender-specific response warrants further investigation to optimize treatment strategies for different patient populations (19).

The strengths of our study included a well-defined patient population and rigorous randomization procedures, which enhanced the validity of our findings. However, the study also had limitations, such as the relatively small sample size and the potential for unmeasured confounding variables. Future research should aim to address these limitations by including larger, more diverse populations and exploring the mechanisms underlying the observed differences in treatment efficacy (20).

## CONCLUSION

Based on the results, magnesium sulfate was found to be a more effective and faster-acting medication compared to the combination of dexamethasone and metoclopramide for the treatment of acute migraine headaches. This finding underscores the potential of magnesium sulfate as a preferred option for rapid pain relief in clinical settings, particularly for female patients. Further research is recommended to standardize treatment protocols and explore the long-term benefits of magnesium sulfate in preventing migraine recurrence.

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