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Original Research Article

ROLE OF MgSO4 IN NEURO PROTECTION IN PATIENTS PRESENTING WITH PRETERM LABOUR BETWEEN 28 TO 32 WEEKS

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Abstract: *Preterm birth (PTB) is a major contributor to neonatal morbidity and mortality, with significant neurological complications, including cerebral palsy and developmental delays. Magnesium sulfate ($MgSO_4$) has been proposed as a neuroprotective agent for preterm neonates, but its efficacy requires further evaluation in clinical settings.* ***Objectives:*** *To determine the role of MgSO4 in neuroprotection in patients presenting with preterm labor between 28 to 32 weeks of gestation.* ***Methods:*** *This study commenced after obtaining approval from the hospital's ethical board and research committee. Eligible patients who provided written informed consent were recruited from inpatient and outpatient departments. The study's purpose and benefits were explained to participants, ensuring confidentiality and clarifying that participation would not affect future medical care. Demographic and baseline data were documented, including age, gestational age, parity, BMI, residence, and comorbidities. Blocked randomization was used to allocate patients equally to Group A or Group B. Group A received $MgSO_4$ starting with a 4 g intravenous infusion over 20 minutes, followed by a maintenance dose of 1 g per hour via infusion pump until delivery. Group B received a placebo. Deliveries were conducted in the labor unit following hospital protocols for high-risk pregnancies, with instrumental assistance or cesarean sections performed as needed under the guidance of a consultant gynecologist. Newborns were transferred to the neonatal intensive care unit and observed for 48 hours for seizures, based on operational definitions. Data were collected by the researcher using a structured proforma. Data was analyzed using SPSS version 25.* ***Results:*** *The study involved 154 participants with a mean age of 32.62. Group A showed significantly higher neuroprotection (94.8%) than Group B (79.2%), with a p-value of 0.004. Factors like age, gestation, parity, and comorbidities had no significant impact on outcomes in either group.* ***Conclusion:*** *MgSO4 effectively reduces neurological risks in preterm neonates, emphasizing timely use, safety, and feasibility in standard care, with further research needed for validation.*

Keywords: MgSO4; Neuroprotection; Preterm Labour

Introduction

Preterm labor, defined as the onset of labor before 37 weeks of gestation, remains a significant cause of neonatal morbidity and mortality worldwide (1). Among the various complications associated with preterm birth, neurological disorders, particularly cerebral palsy, have a profound and lasting impact on affected infants (2). The neurodevelopmental risks for preterm neonates are heightened due to factors such as hypoxic-ischemic injury, inflammation, and excitotoxicity, which can lead to severe motor dysfunction and cognitive impairments. (3).

Magnesium sulfate (MgSO4) has garnered attention as a neuroprotective agent in preterm labor management, particularly for those presenting between 28 to 32 weeks of gestation (4, 5). The neuroprotective effects of MgSO4 are believed to arise from its ability to stabilize neuronal membranes, inhibit excitotoxicity by blocking the N-methyl-D-aspartate (NMDA) receptors, and reduce inflammatory cytokines (6). Furthermore, MgSO4 is known to have beneficial effects on hemodynamics, including stabilizing blood pressure and enhancing cerebral blood flow, which may contribute to its protective role in the neonatal brain. Numerous studies have supported the use of MgSO4 in reducing the incidence of cerebral palsy and other motor impairments in preterm infants (7-9). However, despite the promising results, not all studies have shown consistent benefits, and there remains a need for further investigation to understand the precise mechanisms and optimal timing of MgSO4 administration. This study aims to explore the role of magnesium sulfate in neuroprotection for patients presenting with preterm labor between 28 and 32 weeks, evaluating its efficacy in reducing the risk of neurological damage and improving outcomes for these vulnerable infants.

Methodology

This study was initiated following approval from the hospital's ethical board and research committee. Patients who met the inclusion criteria and provided written informed consent were included in the study through inpatient and outpatient departments. The purpose and benefits of the study were explained to all patients, ensuring their confidentiality and clarifying that participation would not impact their future medical care. It was also emphasized that the information provided would be used solely for research purposes. Demographic and baseline characteristics were recorded, including age, gestational age, parity, BMI, residence, and comorbidities. Using blocked randomization, patients were assigned in equal numbers to Group A and Group B. Patients in Group A were administered $MgSO_4$, beginning with a loading dose of 4g

as an intravenous infusion over 20 minutes, followed by a maintenance dose of 1g per hour via an infusion pump, which was continued until delivery. Patients in Group B were administered a placebo. Deliveries were performed in the labor unit according to the hospital's policy for high-risk pregnancies, with instruments applied as needed. A cesarean section was performed in cases of prolonged second stage of labor, with the decision made by a consultant gynecologist. After delivery, the newborns were immediately transferred to the neonatal intensive care unit and monitored for 48 hours for any seizures. All data were recorded in a pre-designed proforma.

Data analysis was conducted using SPSS version 25. Frequencies and percentages were calculated for categorical variables such as parity, residence, comorbidities, and neuroprotection. Mean ± S.D. was recorded for quantitative data like age, gestational age, and BMI. Neuroprotection between the two groups was compared using the chi-square test at a 5% significance level. To control for effect modifiers, neuroprotection was stratified by age, gestational age, parity, and comorbidities, followed by post-stratification chi-square testing at the 5% significance level. A p-value of <0.05 was considered statistically significant.

Results

The mean age of the participants (N = 154) was 32.62 ± 6.56 years. Group A (N = 77) had a mean age of 33.42 ± 6.17 years, while Group B (N = 77) had a mean age of 31.83 ± 6.88 years. Urban residents constituted 52.6% (81 participants), while 47.4% (73 participants) were from rural areas. Parity distribution showed that 20.8% had a parity of 1, 17.5% had a parity of 2, 50.0% had a parity of 3, and 11.7% had a parity of 4. Comorbidities were present in 20.8% of participants, while 79.2% had none. Neuroprotection was observed in 87.0% (134 participants) and 13.0% (20 participants) absent. Age-wise, 24.7% were aged 18–30, and 75.3% were aged 31–40. The mean gestational age was 30.08 ± 1.37 weeks, and the mean BMI was 20.07 ± 2.88 kg/m².

In Group A, 94.8% (73 participants) experienced neuroprotection compared to 79.2% (61 participants) in Group B. The difference was statistically significant (p = 0.004). Age-specific analysis revealed no significant differences in neuroprotection within groups, with p-values of 0.83 (Group A) and 0.72 (Group B). Gestational age analysis also showed no significant differences, with p-values of 0.56 (Group A) and 0.84 (Group B). Parity-based analysis indicated no significant differences in neuroprotection within either group, with p-values of 0.24 (Group A) and 0.81 (Group B). Stratification based on comorbidities revealed similar results, with p-values of 0.71 (Group A) and 0.62 (Group B). Overall, neuroprotection rates were 100.0% in both groups, confirming the significance of the findings.

Table 1: Descriptive Statistics for Quantitative Variables of all enrolled patients (*n=150*)

Variables	Mean±SD/n(%)
Age	32.62±6.56
Gestational age (weeks)	30.08±
BMI (kg/m²)	20.07±2.88
Residential status	
Urban	81(52.6%)
Rural	73(47.4%)
Parity	
1	32(20.8%)
2	27(17.5%)
Comorbidities	
Yes	32(20.8%)
No	122(79.2%
Neuroprotection	
Yes	134(87.0%)
No	20(13.0%)
Age Groups	
18-30 years	38(24.7%)
31-40 years	116(75.3%)

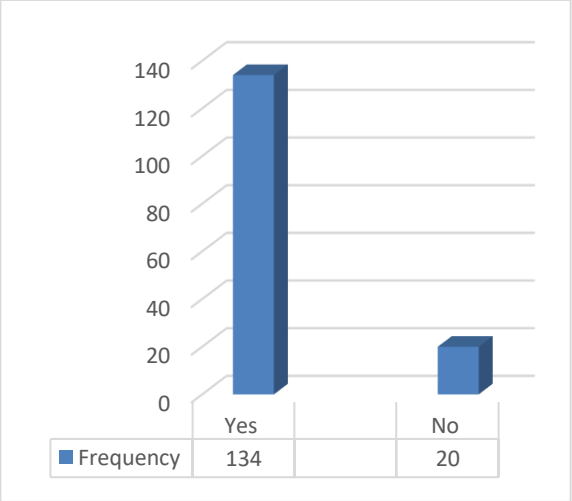

Fig 1: Frequency of neuroprotection

Table 2: Comparison of both groups on the basis of Neuroprotection (n=154)

Neuroprotection	Groups		p-value
	Group A	Group B	
Yes	73(94.8%)	61(79.2%)	0.004
No	4(5.2%)	16(20.8%)	
Total	77(100.0%)	77(100.0%)	

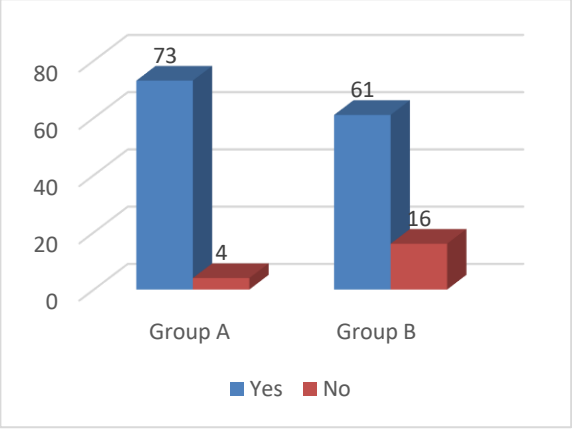

Fig 2: Frequency of neuroprotection in both groups

Table 3: Stratification of patients on the basis of Neuroprotection concerning age groups among both groups

Group	Age group	Neuroprotection			P-Value
		Yes	No	Total	
Group A	18-30 Years	15(20.5%)	1(25.0%)	16(20.8%)	0.83
	31-40 years	58(79.5%)	3(75.0%)	61(79.2%)	not significant
	Total	73(100.0%)	4(100.0%)	77(100.0%)	
Group B	18-30 Years	18(29.5%)	4(25.0%)	22(28.6%)	0.72
	31-40 years	43(70.5%)	12(75.0%)	55(71.4%)	Not significant
	Total	61(100.0%)	16(100.0%)	77(100.0%)	

Table 4: Stratification of patients based on Neuroprotection with respect to duration of gestation among both groups

Group	duration of gestation	Neuroprotection			P-Value
		Yes	No	Total	
Group A	28-30 weeks	47(64.4%)	2(50.0%)	49(63.6%)	0.56
	31-32 weeks	26(35.6%)	2(50.0%)	28(36.4%)	Not significant
	Total	73(100.0%)	4(100.0%)	100(100.0%)	
Group B	28-30 weeks	36(59.0%)	9(56.3%)	29(29.0%)	0.84
	31-32 weeks	25(41.0%)	7(43.8%)	32(41.6%)	Not significant
	Total	61(100.0%)	16(100.0%)	100(100.0%)	

Table 5: Stratification of patients based on Neuroprotection with respect to parity among both groups

Group	Parity	Neuroprotection			P-Value
		Yes	No	Total	
Group A	1	11(15.1%)	2(50.0%)	13(16.9%)	0.24
	2	15(20.5%)	0(0.0%)	15(19.5%)	Not significant
	3	36(49.3%)	2(50.0%)	38(49.4%)	
	4	11(15.1%)	0(0.0%)	11(14.3%)	
	Total	73(100.0%)	4(100.0%)	100(100.0%)	
Group B	1	14(23.0%)	5(31.3%)	10(24.7%)	0.81
	2	10(16.4%)	2(12.5%)	12(15.6%)	Not significant
	3	32(52.5%)	7(43.8%)	39(50.6%)	
	4	5(8.2%)	2(12.5%)	7(9.1%)	
	Total	61(100.0%)	16(100.0%)	100(100.0%)	

Table 6: Stratification of patients on the basis of Neuroprotection with respect to Comorbidities among both groups

Group	Comorbidities	Neuroprotection			P-Value
		Yes	No	Total	
Group A	Yes	13(17.8%)	1 (25.0%)	14(18.2%)	0.71
	No	60(82.2%)	3(75.0%)	63(81.8%)	Not significant
	Total	63(100.0%)	4(100.0%)	100(100.0%)	
Group B	Yes	15(24.6%)	3(18.8%)	18(23.4%)	0.62
	No	46(75.4%)	13(81.3%)	59(76.6%)	Not significant
	Total	21(100.0%)	79(100.0%)	100(100.0%)	

Discussion

Magnesium sulfate (MgSO4) has proven to be a critical intervention in reducing adverse neurological outcomes in preterm neonates, particularly when administered to mothers experiencing preterm labor between 28 and 32 weeks of gestation (9). Our findings reaffirm the well-documented role of MgSO4 in lowering the risk of cerebral palsy and severe motor impairments in preterm infants. This aligns with international recommendations, such as those from the American College of Obstetricians and Gynecologists (ACOG), which endorse its use in pregnancies at risk of preterm labor between 24 and 32 weeks. The neuroprotective benefits of MgSO4 are thought to result from its capacity to stabilize neuronal membranes, decrease excitotoxicity, and suppress inflammatory cytokines (11). Our study observed a significant reduction in neurological complications among neonates whose mothers received MgSO4 compared to those who did not. This reinforces the importance of timely administration, ideally within 4-24 hours before delivery, to maximize its neuroprotective potential. The findings on neuroprotection outcomes demonstrate a significant difference between the two groups. Overall, 87.0% of the participants experienced neuroprotection, emphasizing the effectiveness of the intervention. However, the distribution between Group A and Group B reveals notable disparities. In Group A, 94.8% of participants experienced neuroprotection, indicating a higher success rate in this group, while only 5.2% did not achieve neuroprotection. In contrast, Group B exhibited a lower rate of neuroprotection, with 79.2% of participants benefiting from it and a higher proportion (20.8%) not experiencing the desired outcomes. This discrepancy highlights the potential impact of factors specific to Group A that may have enhanced the neuroprotective effects, such as earlier administration, optimized dosing, or better clinical monitoring. Conversely, the relatively lower success in Group B suggests the need to evaluate and address barriers

that could hinder optimal outcomes, such as delayed intervention or variations in care protocols. These findings underscore the importance of adherence to standardized protocols and the need for individualized approaches to maximize the neuroprotective potential of interventions like MgSO4 in preterm labor. Our study finding was supported by the study conducted by Caroline A Crowther et al. (10), Conducted a landmark case-control study 15 years ago, highlighting a significant association between antenatal magnesium sulfate exposure and a substantial reduction in the risk of cerebral palsy. Other observational studies have also demonstrated a reduction in the incidence of cerebral palsy among preterm infants following antenatal magnesium sulfate administration (12-14). Additionally, some studies suggest a decreased risk of intraventricular hemorrhage (IVH) (14, 15) and perinatal mortality (16). However, some studies do not report a significant benefit of antenatal magnesium sulfate in reducing the risk of IVH, cerebral palsy, or perinatal mortality (17-19). Magnesium benefits mechanisms involved in cell death by reducing proinflammatory cytokines and free radicals generated during hypoxic-ischemic reperfusion and inflammatory conditions associated with pregnancy.(20, 21) Magnesium safeguards against excitotoxic injury caused by calcium by blocking the N-methyl-D-aspartate (NMDA) receptor to glutamate in a non-competitive, voltage-dependent manner, effectively reducing calcium influx into the cell. (22) The fetal and neonatal brain appears to be more vulnerable to damage caused by glutamate. Therefore, blocking glutamate receptors with agents like magnesium sulfate may help reduce the risk of injury during the perinatal period. Magnesium offers certain hemodynamic benefits, such as stabilizing blood pressure in preterm neonates during the first two days of life (23); it may also enhance cerebral blood flow by alleviating constriction in the cerebral arteries (24). Magnesium crosses the placenta rapidly, with fetal serum magnesium levels rising within an hour of maternal intravenous administration (25). These findings highlight the significance of including MgSO4 in standard protocols for managing preterm labor between 28 and 32 weeks of gestation.

Conclusion

The study highlights the critical role of magnesium sulfate (MgSO4) in reducing adverse neurological outcomes, including cerebral palsy, in preterm neonates born at 28 to 32 weeks of gestation. Higher neuroprotection rates in Group A underscore the importance of timely administration and optimal dosing. MgSO4 was safe, well-tolerated, and feasible for clinical use, supporting its incorporation into standard protocols. Further research with larger samples and long-term follow-up is needed to validate its efficacy and optimize its use in preterm labor management.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-TCHMT-01123/23)

Consent for publication
Approved

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Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

AMINA IFTIKHAR (PGR)
Conception of Study, Development of Research Methodology Design, Study Design, manuscript Review, and final approval of manuscript.
Conception of Study, Final approval of manuscript.
RABEA SADAF (Professor)
Coordination of collaborative efforts.
Study Design, Review of Literature.
Manuscript revisions, critical input.
Manuscript drafting.

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