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Original Research Article

Magnesium Sulfate: Seeking the Unknown

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Abstract

Introduction: Although the mortality rate for preterm infants and the gestational age-specific mortality rate have dramatically improved over the last three to four decades, infants born preterm remain vulnerable to many complications, including respiratory distress syndrome, chronic lung disease, and injury to the intestines, a compromised immune system, cardiovascular disorders, hearing and vision problems, and neurological insult.

Aims and Objectives: To determine the effect of exposure of antenatal magnesium sulfate on neonatal APGAR score at 1 minute and 5 minutes of birth, on need of respiratory support and duration of hospitalization of neonates.

Materials and Methods: This prospective interventional study was conducted on 70 women admitted to labor room in the Department of Obstetrics and Gynaecology, Sawai Mansingh Medical College, Jaipur. Women with singleton pregnancy between 28 to 32 weeks gestational age with expected delivery within 24 hours were included. Groups were allocated using flip coin method into cases and controls, and the treatment group was administered with Magnesium Sulphate. At birth Apgar scoring at 1 and 5 minutes were noted. Duration of stay of hospitalisation, need of oxygen, CPAP/ventilator were noted.

Results: The APGAR score at 1 and 5 minutes after birth were found to be improved in the $MgSO_4$ group. The mean duration of stay in the hospital among neonates who received $MgSO_4$ was 9.86 days compared to 11.06 days in controls. Also babies requiring CPAP/ventilator were more in control group as compared to who did not received $MgSO_4$.

Conclusion: Antenatal $MgSO_4$, if judiciously used, can do wonders. But for generalized norms, it has to be evaluated thoroughly.

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Introduction

Preterm births continue to be one of the most significant public health issues, even in affluent countries, because of their significant difference on the entirety of paediatric morbidity and mortality .Babies born prematurely often face a range of complications due to their underdeveloped organs and systems. Common issues include respiratory distress from immature lungs, which can lead to conditions like respiratory distress syndrome and bronchopulmonary dysplasia.

Cardiovascular concerns such as patent ductus arteriosus and hypotension are also prevalent. [1]Neurological complications, including intraventricular hemorrhage and periventricular leukomalacia, can affect brain development and function. Additionally, preterm infants may suffer from gastrointestinal problems like necrotizing enterocolitis and feeding difficulties, as well as an increased susceptibility to infections due to an immature immune system Metabolic issues like hypoglycemia and electrolyte imbalances are common, along with challenges in maintaining body temperature. Despite advances in neonatal care, preterm births require intensive management

and ongoing follow-up to address and mitigate these potential complications.

Antenatal magnesium sulfate ($MgSO_4$)[2] could possibly alleviate these complications. Administered to the mother, magnesium sulfate acts primarily as a neuroprotective agent for the premature infant. It has been shown to significantly decrease the incidence of cerebral palsy and other neurological impairments by protecting the brain from damage that can result from preterm birth. Various methods are known to evaluate their overall health and determine if immediate medical intervention is needed.

The APGAR score is a quick and simple assessment performed on a newborn at one and five minutes after birth [3].A higher score indicates better overall health, while a lower score may suggest that the baby needs medical attention. Therefore it helps healthcare providers quickly assess the newborn's condition and make decisions about the need for immediate care or intervention. Preterm infants often require respiratory support due to their immature lung development and associated breathing difficulties [4].

Born before their lungs are fully developed, these infants frequently lack adequate surfactant, a substance essential for keeping the tiny air sacs in the lungs open and functioning properly. As a result, they are at high risk for respiratory distress syndrome (RDS), characterized by severe breathing difficulties.

Additionally, magnesium sulfate helps in the prevention of respiratory distress syndrome by promoting better lung development. Factors such as respiratory issues, infections, feeding difficulties, and developmental concerns influence the length of hospitalization. As medical advancements improve, the duration of hospitalization for preterm neonates continues to decrease, though each case is individualized based on the specific needs of the baby. Mitigating some of the risks associated with preterm birth, antenatal magnesium sulfate contributes to improved outcomes and reduces the likelihood of long-term developmental issues for the infant.

Material and Methodology

This is a prospective interventional study conducted in department of Obstetrics and Gynecology, SMS Medical College, Jaipur, Rajasthan, India planned over a period of 1 year(December 2022 to December 2023). It included 70 women admitted in labour room with singleton pregnancy between 28 to 32 weeks gestational age with preterm labor and cervical change (dilatation >or=1 cm ,80 % effacement) and expected delivery within 24 hours.

Following the acquisition of appropriate written and informed consent, a thorough medical history, standard ANC exams and standard ANC investigations were carried out. The flipcoin approach was utilized to divide the groups into treatment and control groups.

Treatment Group: Loading dose with 4g of magnesium sulphate over total of 20-30 minutes followed by maintenance dose of 1g per hour through infusion pump until delivery or 24 hours whichever was earliest and given routine standard treatment according to our hospital protocols for preterm labor.

Control Group: Women given routine standard treatment according to our hospital protocols for pretem labor.

Inclusion Criteria:

1. Singleton pregnancy 28 to 32 weeks gestational age.
2. Preterm labor with cervical change and expected delivery within 24 hours.
3. Patient who understands and willing to participate in the study and give written informed consent.

Exclusion Criteria:

1. Major Congenital malformations.
2. Pregnancy with chronic medical disorders (including severe preeclampsia).
3. Maternal contraindications to magnesium sulfate (eg: myasthenia gravis, renal failure).

APGAR score at 1 minute and 5 minutes of birth noted.

Need of respiratory support and duration of hospitalization of neonates noted.

Result and Discussion

Distribution of participants according to different variables: In the present study, the mean age of participants administered with $MgSO_4$ was 25.4 ± 2.38 years while the mean age of participants not administered with $MgSO_4$ was 26.26 ±2.08 years. The RCOG[5]and NG25[6] recommended offering magnesium sulfate to women who are in established labour or having a planned preterm births within 24 hours before 30 weeks of gestation (as benefit is greatest). FIGO[7] good practice recommendations on magnesium sulfate administration for preterm fetal neuroprotection recommnends its use in pregnancies below 32-34 weeks of gestation.(2021) In our cases, the mean gestational age was 29.84 ± 1.19 weeks, while in our control group, it was 29.97 ± 1.14 weeks. Our study included the participants in the recommended age group parameters for them to be eligible for the greatest therapeutic benefits of antenatal $MgSO_4$ for fetal

neuroprotection. The mean birth weight of infants in study group was 1.39 ±0.21 kg whereas in control group it was 1.33±0.17 kg.

Table 1: Variables

Variables	Cases	Controls	p value
Age of participants (Years)	25.4±2.38	26.26±2.08	0.113
Weight of neonates (kgs)	1.39±0.21	1.33±0.17	0.149
Gestational age (Weeks)	29.84±1.19	29.97±1.14	0.642

Distribution of participants according to APGAR score of neonates at 1 min of birth

Table 2: APGAR

APGAR at 1 min	Cases	Controls
<4	5(14.3)	8(22.9)
4-6	26(74.3)	25(71.4)
>6	4(11.4)	2(5.7)
Total	35(100)	35(100)

Among participants administered with $MgSO_4$ almost three-fourths of participants (75.7%) had APGAR scores of 4-6.14.3% of participants had APGAR scores less than 4 and 11.4% of participants had APGAR scores greater than 6. In participants not administered with $MgSO_4$, the majority (71.4%) of participants had APGAR scores of 4-6, 22.9% of participants had APGAR scores less than 4 and 5.7% of participants had APGAR scores greater than 6.Therefore ,more neonates in the control group had score less than 4 as compared to study group who had more neonates with APGAR score more than 6. The mean APGAR score at 1 minute in our study in $MgSO_4$ group was 5.05 as compared to 4.26 in group not receiving $MgSO_4$ which indicates better health and better conditions of the neonate in the $MgSO_4$ group during labour and delivery circumstances.

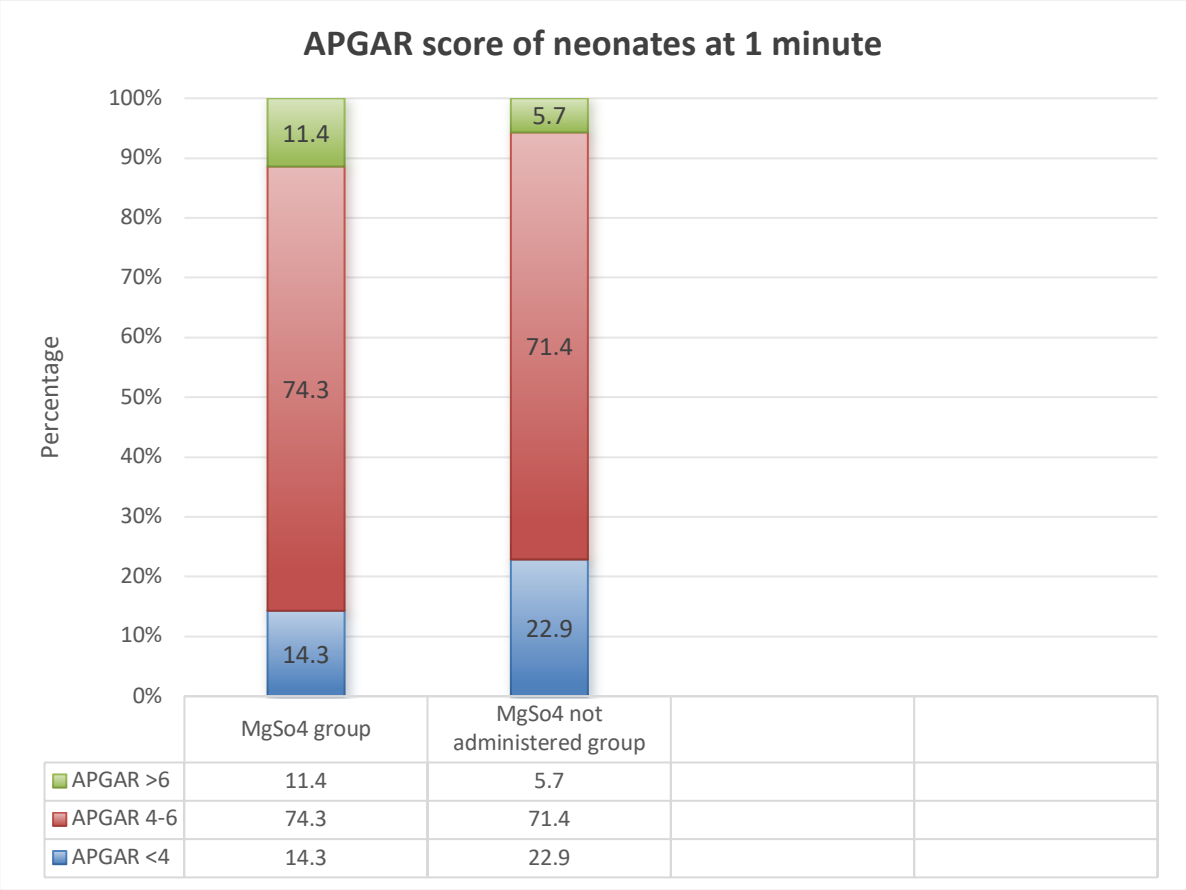

Figure 1: APGAR score of neonates at 1 minute

Distribution of participants according to APGAR score of neonates at 5 mins of birth

Table 3: APGAR

APGAR at 5 min	Cases	Controls
<4	3(8.6)	3(8.6)
4-6	21(60)	28(80)
>6	11(31.4)	4(11.4)
Total	35(100)	35(100)

Among participants administered with $MgSO_4$ the majority (60%) of participants had APGAR scores of 4-6 at 5 minutes.

Almost one third (31.4%) of participants had APGAR scores greater than 6 and rest three (8.6%) participants had APGAR scores less than 4.Among participants not administered with $MgSO_4$, most participants (80%) had APGAR scores of 4-6.11.4% of participants had APGAR scores greater than 6 whereas 8.6% of participants had APGAR scores less than 4.

At 5 mins APGAR score of more than 6 was observed in 31.4% in study group as compared to 11.4% in control group. The mean APGAR score at 5 minutes in cases was 5.65 as compared to 5.17 in control group.

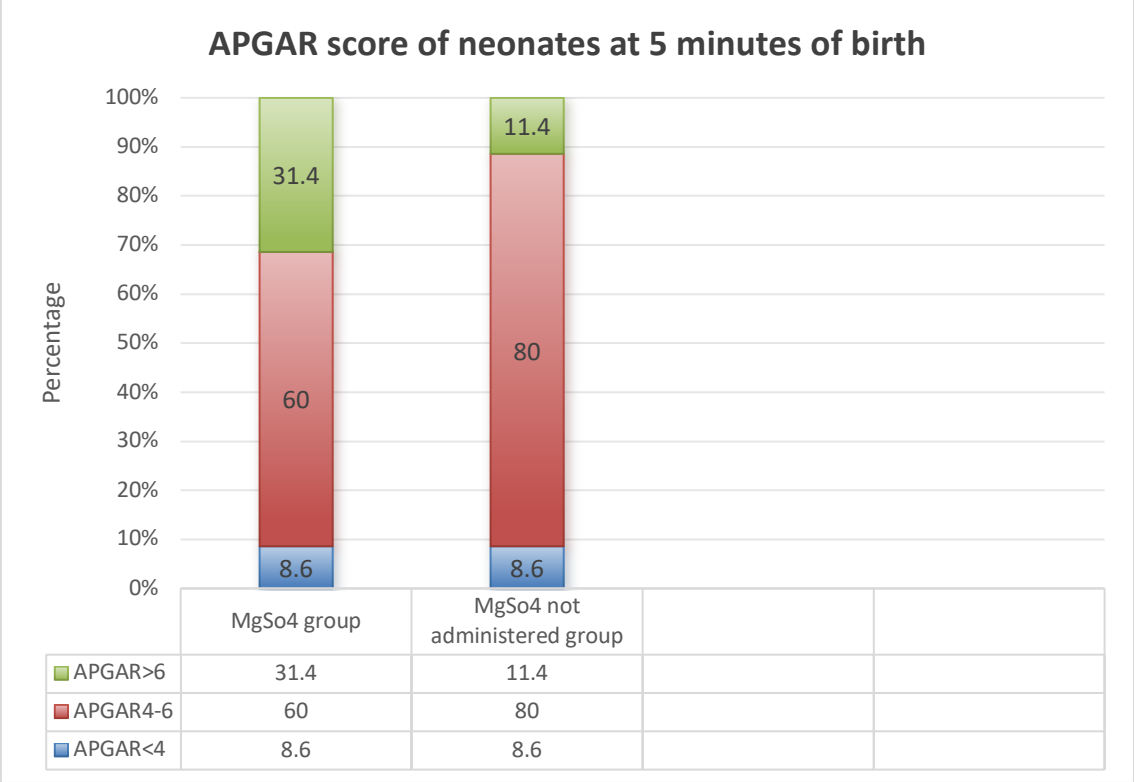

Figure 2: APGAR score of neonates at 5 minutes of birth

Distribution of participants according to duration of stay (Days) of neonates in hospital

Table 4: Duration of stay

Duration of stay (Days)	Cases	Controls
1-3	7(20)	5(14.3)
4-7	8(22.9)	11(31.4)
8-14	14(40)	13(37.1)
>14	6(17.1)	6(17.1)
Total	35(100)	35(100)

The present study shows the duration of hospital stay among neonates who received $MgSO_4$, maximum neonates(40%) stayed for 8-14 days followed by eight neonates (22.9%) who stayed for 4-7 days and six (17.1%) stayed for more than 14 days. Almost similar distribution of participants in terms of duration of hospital stay of neonates was observed in the control group.

The mean duration of stay in the hospital among neonates who received $MgSO_4$ was 9.86±8.42 days, while among controls without $MgSO_4$ it was 11.06±9.30 days.

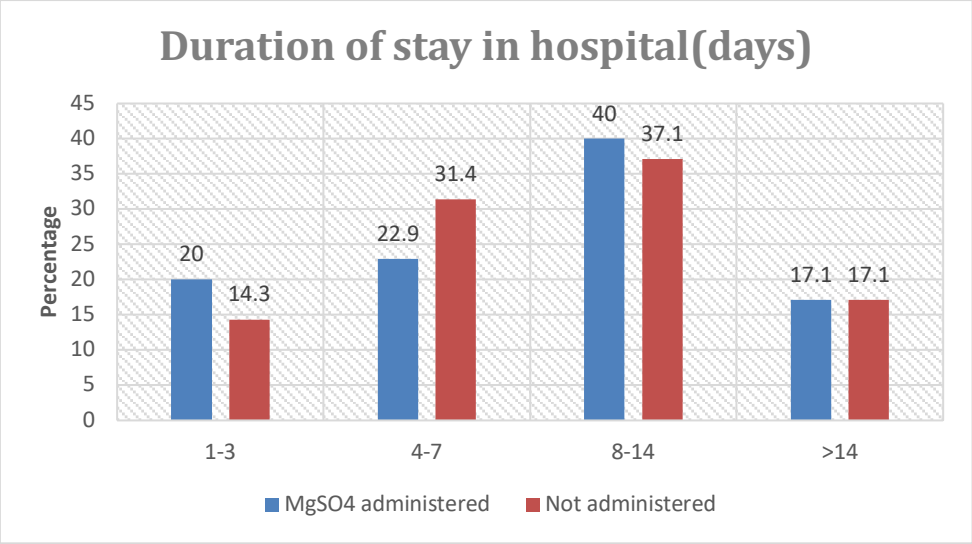

Figure 3: Duration of stay in hospital(days)

Distribution of participants according to need of oxygen support by neonates

Table 5: Need of oxygen support

Need of oxygen support	Cases	Controls
CPAP	16(45.7)	18(51.4)
No support	11(31.4)	6(17.1)
Room air	0	2(5.7)
Ventilator	8(22.9)	9(25.7)
Total	35(100)	35(100)

Among participants with $MgSO_4$, almost half of them (45.7%) required CPAP, and one third (31.4%) did not required any oxygen assistance.

While among participants with no $MgSO_4$, half of them (51.4%) required CPAP, and only six (17.1%) did not required any oxygen support. Eight neonates in study group required ventilator support (22.9%) as compared to nine neonates (25.7%) in the control group.

Compared to 17.1% in the control group, a higher percentage of newborns (31.4%) in the study group did not required any respiratory support. Additionally, the control group had a higher number of newborns in need of CPAP.

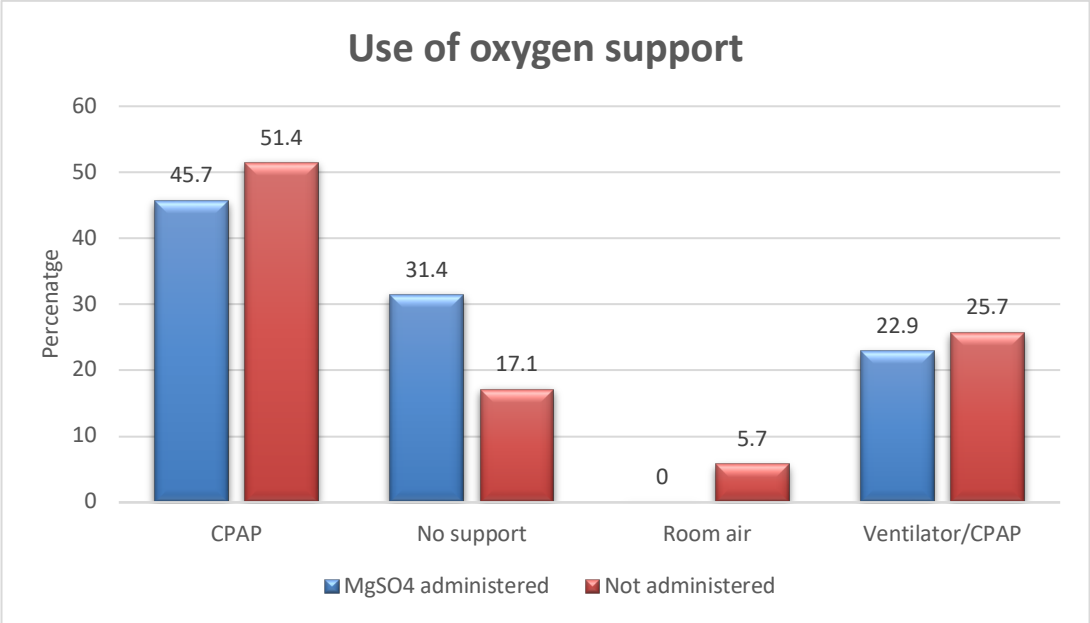

Figure 4: Use of oxygen support

Discussion

The complications of preterm birth arise from immature organ systems that are not yet prepared to support life in the extrauterine environment. The risk of acute neonatal illness decreases with gestational age, reflecting the fragility and immaturity of the brain, lungs, immune system, kidneys, skin, eyes, and gastrointestinal system. In general, more immature preterm infants require more life support. Numerous of these issues have long-term effects on the development, growth, and health of prematurely born children. While a few treatments for neonates have been shown to be safe and beneficial in some randomized, controlled studies, most common treatments and interventions have not received enough research attention.

Antenatal $MgSO_4$ has shown promising results in previous studies. Further research work needs to be done to proove its promising nature.

Nidhi et al[8] (2021) found 1 minute APGAR score was >6 in 64% in $MgSO_4$ group as compared to 34% in control group while APGAR score of <4 was present in 8% in study vs 12% in control group and also discovered APGAR score at 5 minutes to be better in study group.

The APGAR score alone cannot be considered to be evidence of or a consequence of asphyxia. However, a low 5 minute APGAR score clearly confers an increased relative risk of cerebral palsy which is reported to be as high as 20 fold to 100 fold over that of infants with a 5 minute APGAR score of 7-10.[9]

According to Bansal et al.[10](2021), 9 / 50(18%) newborns who were treated to prenatal magnesium sulfate required intubation compared to 13/50 (26%) neonates who were not exposed to it . Only 16/50 (32%) of the neonates in the $MgSO_4$ group required complete ventilation or CPAP, compared to 24/50 (48%) in the non- $MgSO_4$ group. Similar to our study, fewer neonates in the $MgSO_4$ group required intubation at birth (32% vs 52%) as shown by Ayed et al in his study.[11] Bansal et al evaluated 83 infants for the number of days they stayed in the NICU. The average number of days in NICU was comparable to our findings as the stay was shortened by 2 days in $MgSO_4$ group.[12]

Conclusion

Though the present study showed that MgSo4 given antenatally in preterm births could be a life saviour, but underlying mechanism could not be thoroughly explained.

For many years, attention has focused on high-risk obstetric and neonatal intensive care for extremely preterm infants and infants born at the lower limit of viability. It is important to keep in mind that these larger preterm infants are vulnerable to complications and disabilities than full-term infants. Long-term health and neurodevelopmental outcomes should be the focus of new trials of treatments and intervention strategies for neonates

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