



SERUM MAGNESIUM AND CALCIUM STATUS IN TERM ASPHYXIATED NEWBORNS WITH HYPOXIC-ISCHEMIC ENCEPHALOPATHY

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ABSTRACT:

Objective: To examine the serum magnesium and calcium status in term asphyxiated newborns with hypoxic-ischemic encephalopathy.

Methodology: Sixty newborns were selected for the study conducted from May 2023 to November 2023 at pediatric department, Lady Reading Hospital, Peshawar. Thirty cases of newborns with asphyxiated HIE were compared with thirty healthy newborns for assessing serum calcium and magnesium.

Results: Mean serum calcium level was 7.54 ± 1.41 mg/dl in cases group while 8.65 ± 0.62 mg/dl in control group ($P = 0.0001$). Mean serum magnesium in cases group was 1.61 ± 0.47 mg/dl while 1.84 ± 0.42 mg/dl in control group ($P = 0.04$).

Conclusion: Serum calcium and serum magnesium were significantly lower in the asphyxiated newborns with hypoxic-ischemic encephalopathy as compared to healthy newborns.

Keywords: Asphyxia, Hypoxic-ischemic encephalopathy, serum calcium, serum magnesium.

INTRODUCTION:

Perinatal hypoxia is a prevalent issue in underdeveloped nations like Pakistan, leading to substantial morbidity and mortality¹. The study found that the total morbidity rate among asphyxiated cases was 27.4%. While 40% of cases in Hypoxic-Ischemic Encephalopathy II and Hypoxic-Ischemic Encephalopathy III resulted in survival². Neonatal tetanus, which occurs primarily in underdeveloped countries, is the third leading cause of mortality among newborns. It is responsible for around 23% of the 4 million neonatal fatalities that occur each year, following infections and premature deliveries³. Hypoxic-ischemic encephalopathy arises due to insufficient oxygen supply and/or reduced blood flow during the process of childbirth^{4,5}.

Primary neuronal injury arises after the occurrence of asphyxia and ceases with the use of resuscitative techniques⁶. The process of secondary neuronal harm persists for a few hours to days, even after the initial event has been reversed⁷. Magnesium is an element that occurs naturally that acts as an antagonist to the NMDA receptor. It works by blocking the entry of calcium into neurons through ion channels, therefore preventing permanent damage to the neurons⁸. Hypocalcaemia is a common characteristic observed in asphyxiated newborns who have decreased levels of calcium⁹. This condition tends to occur in infants who exhibit more severe symptoms of asphyxia. Following childbirth, the levels of calcium begin to decline and reach a low point of 7.5-8.5mg/dl in healthy full-

term infants by the second day of life ¹⁰.

Serum calcium levels return to normal by the third day of life. The transition phase is accountable for the heightened susceptibility to early onset hypocalcemia in high-risk neonates, such as newborns with perinatal hypoxia ¹¹. The underlying causes of perinatal hypoxic-ischemia has been extensively studied to determine the specific factors that need to be targeted in order to minimize neurological damage in newborns ^{12, 13}. Imbalances in magnesium and calcium levels are commonly observed in infants who have experienced asphyxia, and these abnormalities are strongly linked to unfavorable outcomes ^{14, 15}.

This study intends to address significant knowledge gaps about the metabolic environment associated with hypoxic-ischemic encephalopathy by examining the levels of serum magnesium and calcium in term asphyxiated neonates. The findings obtained from this study has the capacity to influence the methods used in medical treatments, provide guidance for future research efforts, and eventually enhance the results for neonates struggling with the effects of prenatal hypoxia.

MATERIAL AND METHODS:

This case control trial was conducted at department of pediatrics Lady Reading Hospital, Peshawar from May 2023 to November 2023. We selected sixty newborns for the study, thirty asphyxia newborns having APGAR score 0 to 6 with mild to moderate HIE were allocated to the cases group, HIE severity was diagnosed after physical and clinical examination. Thirty healthy newborns with no asphyxia were allocated to the control group. Newborns with still birth and growth restriction anomalies were excluded from the study All the newborns were term babies delivered either through normal vaginal delivery or caesarean section. We collected all the demographic information on the newborns on a pre-designed proforma. Blood samples from all newborns were taken and sent to the hospital laboratory for assessing the serum calcium and magnesium levels. All the information was recorded and analyzed in SPSS version 23. We deployed independent samples T test and Chi Square test for assessing numerical and categorical data between cases and controls. P value was set at < 0.05 for significance.

RESULTS:

We selected sixty newborns for this study, thirty newborns were allocated to cases group while thirty newborns were allocated to control group. There were 2 (6.7%) newborns having age < 30 mins, there were 21 (70%) newborns having age 30 mins to 24 hours while there were 7 (23.3%) newborns having age greater than 24 hours in cases. Mean gestational age in cases group was 39.37±1.47 weeks while 39.83±1.64 weeks in control group. In control group there were 3 (10%) newborns having age < 30 mins, there were 19 (63.3%) newborns having age 30 mins to 24 hours while 8 (26.7%) had age greater than 24 hours. In cases group there were 19 (63.3%) male while 11 (36.7%) female newborns and in control group there were 22 (73.3%) male while 8 (26.7%) female newborns. Regarding the mode of delivery, in cases 7 (23.3%) newborns were born through normal vaginal delivery while 23 (76.7%) were born through caesarean section, in control group 22 (73.3%) newborns were born through normal vaginal delivery while 8 (26.7%) were born through caesarean section. Mean APGR score in cases was 3.13±1.45 while 8.60±1.03 in control group (P = 0.0001). Mean serum calcium level was 7.54±1.41 mg/dl in cases group while 8.65±0.62 mg/dl in control group (P = 0.0001). Mean serum magnesium in cases group was 1.61±0.47 mg/dl while 1.84±0.42 mg/dl in control group (P = 0.04).

Figure 1 Gender distribution

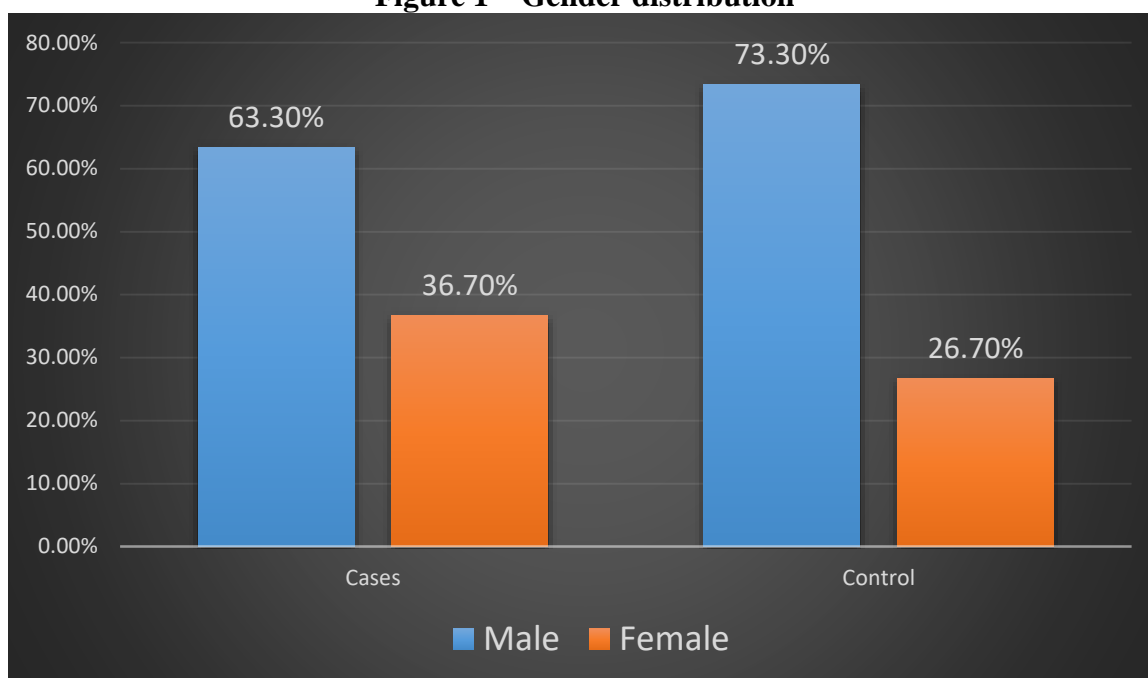


Table 1 Comparison of APGAR score, serum calcium and serum magnesium between both groups

Variables	Groups	N	Mean	Std. Deviation	P value
APGAR score	Cases	30	3.13	1.456	0.0001
	Control	30	8.60	1.037	
Serum calcium (mg/dl)	Cases	30	7.5823	1.41948	0.0001
	Control	30	8.6583	.62066	
Serum magnesium	Cases	30	1.6110	.47721	0.04
	Control	30	1.8490	.42599	

Table 2 Hypocalcaemia and hypomagnesaemia in both groups

		Groups				P value
		Cases		Control		
		N	%	N	%	
Hypocalcaemia	Yes	14	46.7%	3	10.0%	0.002
	No	16	53.3%	27	90.0%	
Hypomagnesaemia	Yes	11	36.7%	4	13.3%	0.03
	No	19	63.3%	26	86.7%	

DISCUSSION:

Hypoxic-ischemic encephalopathy (HIE) continues to be a major contributor to illness and death among newborns, affecting infants who experience a lack of oxygen during the birthing process.¹⁶ It is important to comprehend the changes in serum magnesium and calcium levels in term asphyxiated neonates in order to investigate possible connections with the severity of HIE and enhance therapeutic treatment. The precise regulation of magnesium and calcium levels is crucial for proper brain function, making them important indicators for evaluating the severity of hypoxia injury.¹⁷

Magnesium levels in the blood: Magnesium, a vital cation found within cells, plays a crucial part in safeguarding the nervous system by controlling the release of neurotransmitters, functioning of ion channels, and anti-inflammatory mechanisms. Research has indicated that neonates who have experienced hypoxia and have hypoxic-ischemic encephalopathy (HIE) may show changes in their

serum magnesium levels. Hypoxia-ischemia can disturb the balance of magnesium inside cells, resulting in a decrease in the amounts of magnesium in the blood. It is essential to comprehend these alterations, as a lack of magnesium has been linked to heightened susceptibility of neurons and worsening of hypoxia damage.¹⁸

Calcium is an essential divalent cation that has a critical function in neurotransmission, neuronal excitability, and cell viability. The examination of the effect of hypoxia-ischemia on serum calcium levels in term asphyxiated neonates is currently being actively pursued. Disrupted calcium balance may worsen the neurological effects of HIE by causing excitotoxicity and cell death. Detecting abnormalities in serum calcium levels could provide valuable information about the extent of hypoxia injury and help direct treatment strategies to reduce long-term brain damage.¹⁹

Practical Applications: Evaluating the levels of magnesium and calcium in the blood of neonates with HIE (hypoxic-ischemic encephalopathy) at term shows potential for enhancing the early detection and prediction of outcomes. Tracking these electrolytes can assist clinicians in categorizing the extent of HIE and customizing therapeutic interventions accordingly. Furthermore, therapies aimed at restoring the balance of magnesium and calcium in the body have the potential to reduce neuronal damage and improve tactics for protecting the nervous system. Additional investigation is necessary to demonstrate strong connections between the levels of magnesium and calcium in the blood and the severity of HIE, which will facilitate the development of specific therapy strategies.^{19, 20}

We conducted our study on 60 newborns having birth age 5 minutes to 48 hours. We divided our patients in cases and control. In cases group, thirty patients were selected having APGAR score less than or equal to 6, clinically diagnosed with mild to severe hypoxic-ischemic encephalopathy while thirty healthy babies were allocated to control group.

Our findings revealed that there was no notable difference between the age of the newborns and the gestational age of their mothers. We found notable difference in the mode of delivery, in cases the frequency of caesarean section was higher than control group. Similar findings were reported by a study which showed that the rate of C-section was higher in newborns with asphyxia.²¹

The mean serum calcium and magnesium were notably lower in the cases 7.58 ± 1.41 mg/dl and 1.61 mg/dl when compared with controls 8.65 ± 0.62 mg/dl and 1.84 ± 0.42 mg/dl. Similar results have been reported in a study which showed that the serum calcium and serum magnesium were significantly lower in newborns with HIE.²² We also observed that hypocalcaemia and hypomagnesaemia were notably higher in the cases when compared with healthy controls, the aforementioned study²² also attested to the fact that hypocalcaemia and hypomagnesaemia were notably higher in the newborns with HIE. Another study also found that hypomagnesaemia was notably higher in newborns with HIE²³.

CONCLUSION:

From our study we conclude that serum calcium and serum magnesium were significantly lower in the asphyxiated newborns with hypoxic-ischemic encephalopathy as compared to healthy newborns. Our results also demonstrated that caesarean section had higher frequency in newborns with HIE.

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