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A Prospective Cohort Study On The Impact Of Phototherapy On Serum Magnesium Levels In Infants With Indirect Hyperbilirubinemia.

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ABSTRACT

The objective of this study was to examine newborns with hyperbilirubinemia who had undergone phototherapy in order to ascertain how serum magnesium levels were affected by the treatment.160 infants who were referred to a tertiary care medical facility and had jaundice were the subjects of a prospective cohort research. Based on bilirubin levels, newborns were categorized into three subgroups: mild, moderate, and severe disease, which were each treated with single, double, and extensive phototherapy. Serum levels of magnesium and bilirubin were determined and compared using parametric assays before and after phototherapy. The average age at which jaundice first appeared in the subjects was 3.61 days, and their intrauterine age was 38.41 0.54 weeks. All groups had normal serum magnesium levels prior to phototherapy. The highest decrease in total serum magnesium after phototherapy, however, was seen in the double phototherapy group and was 0.19 0.35mg/dl (P = 0.017). In the single phototherapy and intense phototherapy groups, the change in serum magnesium level was not statistically significant (P > 0:05). In the present investigation, neither of the three groups' serum magnesium levels prior to therapysignificantly increased. After treatment, the double phototherapy group experienced a sizable drop.

Keywords: Phototherapy, serum magnesium level, hyperbilirubinemia

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INTRODUCTION

Jaundice is the most typical medical condition that needs attention in neonates. The development of unconjugated bilirubin results in the yellowing of the sclera and skin. Neonatal jaundice is defined as a total blood bilirubin level greater than the 95th percentile or 5 mg/dl [1]. Nearly 60% of infants born at full term and 80% of premature babies have jaundice [2]. Direct hyperbilirubinemia and indirect hyperbilirubinemia (non-conjugated) are the two main types of jaundice in infants. Direct hyperbilirubinemia does not result in neurotoxicity; however indirect hyperbilirubinemia does and is toxic to the brain. When indirect hyperbilirubinemia builds up in the nerve membrane and reaches dangerous levels for neuronal cells, it irreversibly harms the neurons of the central nervous system.

The detrimental effects of bilirubin's protracted buildup in the neurons of the basal ganglia of the brain include encephalopathy, kernicterus, and athetoid cerebral palsy [3-6]. Magnesium, the fourth-most prevalent cation in the body, is kept inside cells. Magnesium shields the brain system against hypoxia and the neurotoxic effects of bilirubin by blocking the N methyl-D-aspartate (NMDA) receptor. The magnesium ion is one of the most complex antagonist regulators of human bilirubin molecule, ionic channel, and NMDA receptors. The NMDA receptor is made hyperactive by bilirubin, which then has neurological effects by binding to the NMDA, which is necessary for memory and synaptic physiological function [7]. A preventive mechanism against the harmful effects of bilirubin in hyperbilirubinemia may be increased magnesium levels. Phototherapy is the treatment for hyperbilirubinemia that is most usually administered. However, potential side effects include hypocalcemia and hypomagnesemia. Minor side effects of phototherapy include heat, fever, diarrhea, effects on RBCs, cytokines, vitamins, and ocular and dermatological disorders [3-6]. Bilirubin toxicity is caused by unconjugated bilirubin accumulation on the outer membrane of neurons. Intracellular magnesium, which is released from the neurons, RBCs, and cardiocytes, coats the outer membrane. As a result, bilirubin is unable to adhere to the outer membrane. The transport of magnesium from the intracellular to extracellular space is hindered when bilirubin is decreased by phototherapy, which also lowers plasma ionized magnesium and serum magnesium levels [8-10]. The aim of this study was to investigate the effects of phototherapy on serum magnesium levels in babies with hyperbilirubinemia.

MATERIALS AND METHODS

This prospective cohort study was carried out in the Department of Paediatrics and Neonatology at a tertiary care medical center from March2021 to September 2021. All of the children's parents or legal guardians gave written informedconsent before the study began, and the ethics committee gave the study their blessing.

According to a study, prior to phototherapy, the magnesium levels reported standard deviation was 0.36 mg/dl. Because the study hypothesis test had a power of about 80% and could find a change in the serum level of magnesium after phototherapy of 0.125 mg/dl, 10 160 infants were included in the sample size. Based on the total serum bilirubin concentration, the neonates were divided into three groups: mild (15-18 mg/dl), moderate (18-20 mg/dl), and severe (20 mg/dl) jaundice [16], with 52, 57, and 51 infants in each group. Individual, joint, and intensive phototherapy sessions were given to them, accordingly. Intensive phototherapy uses eight fluorescent lamps, four from the upper part and four from the lower part, each with the power of more than 30 microW/cm^2/nm. Single phototherapy uses a device with four lamps, double phototherapy uses two devices with three lamps on either side (upper) and is performed at a distance of 15 to 20 cm from the newborn.

Before beginning phototherapy basic characteristics and demographic data about the neonates were collected, including the mother's age, the level of total serum bilirubin, the level of magnesium, the age at which jaundice first appeared (day), the intrauterine age (week), the weight at admission (g), and whether the delivery was by caesarean section or vaginaldelivery. Atomic absorption spectro photometry was used to detect magnesium, and photometry was used to quantify serum bilirubin. For treatment to be effective, the total serum bilirubin levels have to be fewer than 12 mg/dl. Immediately after the phototherapy treatment period ended, the babies' total serum bilirubin and magnesium levels were checked once more.

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Inclusion criteria

- Full-term neonates with pathogenic hyperbilirubinemia, defined as having an unconjugated bilirubin/total bilirubin ratio of less than 80% and a peak bilirubin level in the blood between 6 and 20 mg/dl within 10 days after delivery in terms.
- Healthy full term infants weighing more than 2500 gm
- Birth age 2-14 days

Exclusion criteria

- Direct bilirubin>20- Exchange transfusion cases.
- Newborns who have a cephalohematoma, a congenital defect, a metabolic disorder, sepsis, or whose mother received magnesium sulphate during pregnancy.
- Hemolytic hyperbilirubinemia.
- Those who did not signed the written informed consent

Statistical analysis

The data entry program utilized was SPSS version 22. The variables were defined using the means and standard deviations (SD) of the quantitative and qualitative variables, respectively. To examine the change in quantitative and qualitative variables, the pair- ample t-test and McNemar's test were used, respectively. The significance threshold was setat 0.05 in each example.

RESULTS

The trial was finished with 160 infants, and the average intrauterine age was 38.4(0.80) weeks (SD). A total of 85 babies, or 53.1%, were born naturally, while 75 babies, or 46.80%, underwent a caesarean section. The remaining information is shown in Table 1.

Table 1: Characteristics of neonates for the treatment groups

Variable	Single		Double		Intensive		P value
	Mean±S	Range	Mean±S	Range	Mean±S	Range	
Jaundice onset age (day)	3.61 ± 1.72	2-11	3:67 ± 1:56	2-9	3:33 ± 1:47	2-10	0.324*
Intrauterine age (week)	38.41 ± 0.54	37-41	38:88± 0:93	38-40	38:87 ± 0:81	38-41	0.033*
Admission weight (gr)	2971 ± 334	2500-3900	3110 ± 367	2500-4150	3016± 361	2500-4002	0.142*
Mother's age (year)	28.17 ± 3.77	17-39	27.45 ± 4.19	16-40	29.87 ± 5.19	16-42	0.104*
	N (%)		N (%)		N (%)		P
Delivery type Vaginal	24 ± 41.0		33 ± 51.7		31 ± 57.7		0.237**
Cesarean	28 ± 42.0		22 ± 38.3		16±32.1		

*One way analysis of variance, ** Chi-square test

The average total serum bilirubin levels for each of the three groups are shown in Table 2. The levels of total serum bilirubin decreased in each group.

Both single and double phototherapy, as shown in table 3, reduced the serum total magnesium levels following treatment, however only the double phototherapy group saw a statistically significant decrease (P=0.016).

In the intense group, this parameter slightly increased, but the difference was not statistically significant (P=0.516).

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All three treatment groups' babies' serum magnesium levels were normal prior to therapy (Table 4). According to each patient's condition, the magnesium concentration in the single, double, and intensive phototherapy groups was 4.3%, 16.2%, and 6.8%, respectively, higher than 2.2 mg/dl.

Table 2: Total serum bilirubin levels before and after single, double, and intensive phototherapy

Phototherapy type	Serum total bilirubin (mg/dl)		Differences (mg/dl)	P value
	Before (Mean±SD)	After (Mean±SD	Mean±SD	
Single	15.98 ± 0.7	7.60 ± 1.28	−6.83 ± 1.16	<0.001
Double	17.49 ± 0.16	8.17 ± 1.67	−8:67 ± 1.25	<0.001
Intensive	21.90 ± 3.19	8.92 ± 1.16	−12.34 ± 2.81	<0.001

*Paired-sample t-test.

Table 3: Serum magnesium levels before and after single, double, and intensivephototherapy

Phototherapy types	Serum magnesium (mg/dl)		Differences (mg/dl)	P value
	Before (Mean±SD)	After (Mean±SD)	Mean±SD	
Single	2.11 ± 0.32	2.04 ± 0.56	−0.02± 0.31	0.602
Double	2.14 ± 0.54	2.09 ± 0.67	−0.19± 0.35	0.017
Intensive	2.04 ± 0.56	2.06 ± 0.81	0.02± 0.42	0.539

* Paired-sample t-test.

Table 4: Serum magnesium status before and after phototherapy in three treatment groups.

Phototherapy	Before phototherapy			After phototherapy			P
	<1.5	1.5-2.2	<2.2	<1.5	1.5-2.2	<2.2	
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	
Single	0(0%)	4 5	7(4.3%)	0 (0%)	39(24.3	12(7.5%)	0.543
Double	2	3 0	26(16.2%	4(2.5%)	4 1	12(7.5%)	0.003
Intensive	2	37(23.1)	11(6.8%)	2 (1.25%)	40(25%)	10(6.25%)	0.913

*McNemar test

DISCUSSION

The condition that demands medical attention and hospital readmission most frequently in newborns is jaundice. The buildup of unconjugated bilirubin in infants with jaundice causes the skin and sclera to turn yellow.A sample of 160 newborns with intrauterine ages of 38.41 0.54 weeks, mean weights of 2971 334g, and mean ages at which jaundice first manifested itself of.3.61 1.72days were studied to compare the total serum magnesium levels before and after treatment. Patients receiving double therapy experienced a significant drop in serum magnesium levels after phototherapy, however patients receiving single or intensive phototherapy did not experience these differences.It is most likely the outcome of elevated magnesium levels in conjunction with hyperbilirubinemia that the magnesium levels are lowered after double phototherapy along with a decrease in bilirubin.

Plasma levels of magnesium also increase in response to rising bilirubin levels, either as a result of cellular breakdown or as a defense mechanism. The results of our investigation are consistent with those of Khosravi et al [11], who found a decrease in total serum magnesium levels after phototherapy. According to Sapkota et al. study [8], which showed a positive relationship between serum magnesium and serum bilirubin levels, the increase in magnesium during hyperbilirubinemia may be a physiological compensatory mechanism that fights the negative effects of bilirubin.

According to three separate studies by Misra et al, Shahriarpanah et al, and Mazary et al. that looked at the relationship between hyperbilirubinemia and different minerals. Infants with hyperbilirubinemia had considerably lower total magnesium levels when compared to controls, and there was no rise in serum magnesium levels proportional to the rise in serum bilirubin levels [12-14]. These results were in agreement with the current study. Our study's findings showed that serum bilirubin levels significantly decreased after phototherapy compared to levels before phototherapy, and blood magnesium levels, both

total and ionized, significantly decreased after phototherapy compared to levels before phototherapy. This was consistent with the later findings.

CONCLUSION

Severe jaundice can affect the nervous system and perhaps cause kernicterus because of bilirubin accumulation in the neuronal membrane. Phototherapy decreases the bilirubin level along with a corresponding decrease in magnesium levels. There is a positive correlation between serum magnesium levels and bilirubin levels. In the current study, only the two-pronged phototherapy strategy showed a significant decrease in serum magnesium levels; the levels in the other two groups remained within the normal range. The serum magnesium level in all three treatment groups was normal prior to treatment and did not significantly increase.

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