ORIGINAL RESEARCH PAPER

Paediatric Medicine

EFFECTS OF PHOTOTHERAPY ON SERUM MAGNESIUM LEVELS

KEY WORDS: Serum Magnesium, Phototherapy, hyperbilirubinemia

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ABSTRACT

Background: Magnesium is one of the key micro-nutrient for body metabolism. However the effects of phototherapy on serum magnesium remain a unsolved debate. Hence this study was conducted to check whether the serum bilirubin levels changes due to phototherapy among the newborns with hyperbilirubinemia. **Methods:** This Observational cross sectional study was done in Meenakshi Medical College Hospital and Research institute, from the period of June 2021 to March 2022. Neonates admitted for treatment of hyperbilirubinemia were included in the study. Serum bilirubin total, direct and indirect levels, serum magnesium were sent for analysis. **Results:** Serum magnesium levels and ionized magnesium levels were not significantly differ with phototherapy, being given for the treatment of neonatal hyperbilirubinemia. **Conclusion:** Without doubts, this study also proved that phototherapy was very effective in reducing the serum total bilirubin levels and direct bilirubin levels however serum magnesium levels were not affected. Therefore, it is suggested that further studies be conducted on the effect of phototherapy on the levels of other serum minerals like calcium, zinc and copper on and preterm and term infants.

INTRODUCTION

Neonatal hyperbilirubinemia (NH) is the most common abnormal finding reported during the first week of life of newborns. Due to excessive accumulation of unconjugated bilirubin, the newborn with hyperbilirubinemia commonly manifests with yellowish discoloration of the skin and sclera, except which the newborn reflects a normal physiological phenomenon[1]. NH affects about 60% of neonates born at term and about 80% of neonates born at preterm. Based on the literature, about 6% of neonates born at term were reported to have serum bilirubin nearly 13 mg% and similarly serum bilirubin over 15 mg% was reported among 3% of neonates who were born at term[2]. Neonatal hyperbilirubinemia occurs due to the liver's immature excretion of bilirubin and it contributes majorly for the readmission of neonates during their first week of life[3]. As a result of neonatal hyperbilirubinemia, the elevated levels of unconjugated bilirubin can eventually lead to development of bilirubin encephalopathy and kernicterus, with permanent neuro-developmental damage[4]. Thus prompt management of neonatal hyperbilirubinemia is highly recommended either by phototherapy or exchange transfusion or pharmacologic agents. Among these treatment modalities, the commonly used one is phototherapy due to reason that majority of the neonates will present with the serum bilirubin range which responds better with phototherapy.

Phototherapy has other beneficial effects in terms of comparatively lower cost, easy availability, low adverse effects and it helps to reduce the requirement exchange transfusion and use of pharmacological agents. As like any other treatment modalities, phototherapy also has its own side effects like hyperthermia, loose stools, feed intolerance, retinal damage, skin rashes, dehydration, dehydration, alterations serum micronutrients especially in magnesium , calcium, etc and genotoxicity[5-7].

Magnesium (Mg) an important mineral in the human body which helps to regulates more than 300 enzymes. It acts as a cofactor for enzymes concerned with glucolysis, cell respiration, and trans-membrane transport[8]. The serum levels of magnesium become higher in serum depending on the existence of mild hemolysis in neonates, the fact that Mg is high in erythrocytes, especially reticulocytes than in serum concentrations, so its serum levels increase after hemolysis[9]. It can affect enzyme activity by binding the active site of the enzyme, by ligand binding, by causing conformational changes during the catalytic process (Na- K- ATPase), and by promoting aggregation of multienzyme complexes[10,11].

Several literature reported that they found a positive correlation between plasma ionized Mg levels and severity of hyperbilirubinemia in newborn[12,13]. Measurement of Ionized Magnesium (IMg) provides an accurate assessment of the free form of Mg, which is the physiologically active form and is most reactive of the biologically active and not easily measurable intracellular Mg fraction[14-16].

OBJECTIVE

To check whether the serum bilirubin levels changes due to phototherapy among the newborns with hyperbilirubinemia

METHODS

This Obsevational cross sectional study was done in Meenakshi Medical College Hospital and Research institute, from the period of June 2021 to March 2022. Neonates admitted for treatment of hyperbilirubinemia were included in the study. Newborn admitted with hyperbilirubinemia was initially examined to look for the extent of icterus. Serum bilirubin total, direct and indirect levels were sent for analysis. 1ml of serum was stored for estimation of serummagnesium. Using that serum sample stored serum magnesium level was estimated before starting phototherapy. A total of 100 neonates were included and all underwent phototherapy. 48 hrs after phototherapy a repeat sample of serum calcium and serum bilirubin total, direct and indirect levels were taken.

The data were entered in MS office excel sheet and analyzed using SPSS version 16. Continuous data with normal distribution was expressed as mean with standard deviation. Independent sample 't' test was used to compare the mean values between the two groups. Paired 't' test was used to compare the means between before and after phototherapy. $P<0.05$ was considered statistically significant.

RESULTS

In the present study, only newborns delivered at term were included. Among them majority of the newborns (37%) were born during 39-39 weeks +6 days of gestation followed by

26% of newborn delivered during 38-38 weeks +6 days of gestation, 17% of newborn delivered during 40-40 weeks +6 days of gestation, 14% of newborn delivered during 37-37 weeks +6 days of gestation and 6% of newborn delivered during 41-41 weeks +6 days of gestation. Among the hundred newborns, 57% of newborns were male and 43% of newborns were females, in this study. In this study majority of the newborns (51%) were born with birth weight between 2.5-3 kgs followed by 28% of newborns born with birth weight between 3.1-3.5 kgs, 14% of newborns born with birth weight more than 3.5 kgs and 7% of newborns born with birth weight less than 2.5 kgs. In the present study, we included only newborns who underwent phototherapy for hyperbilirubinemia. Among them 54% of newborns underwent phototherapy for 3-4 days followed by 35% of newborns underwent phototherapy for less than or equal to two days and 11% of newborns underwent phototherapy for more than 4 days. The mean pre phototherapy weight of newborns was found to be 2.97 kgs and the standard deviation (SD) was found to be 0.38 kgs, in this study.

On comparing the mean pre phototherapy and post phototherapy levels of total bilirubin among the newborns, a mean difference of 9.8 mg/dl was noted with 95% confidence interval of 9.1-10.6 mg/dl. This difference in mean levels of total bilirubin of newborns before phototherapy and after phototherapy was found to be statistically significant with p value of 0.000. On comparing the mean pre phototherapy and post phototherapy levels of direct bilirubin among the newborns, a mean difference of 1.0 mg/dl was noted with 95% confidence interval of 0.9-1.1 mg/dl. This difference in mean levels of direct bilirubin of newborns before phototherapy and after phototherapy was found to be statistically significant with p value of 0.000.

Table 1: Comparison of mean total bilirubin –before and after phototherapy

Variables	Mean values		P value
	Pre phototherapy	Post phototherapy	
Total bilirubin (mg/dl)	17.1±3.2	7.2 ± 2.1	0.000*
Direct bilirubin (mg/dl)	1.6 ± 3.1	0.5 ± 0.3	0.000*

*Significant

On comparing the mean pre phototherapy and post phototherapy levels of serum magnesium among the newborns, a mean difference of 0.1 mg/dl was noted with 95% confidence interval of 0.03-0.12 mg/dl. This difference in mean levels of serum magnesium of newborns before phototherapy and after phototherapy was found to be statistically insignificant with p value of 0.651. On comparing the mean pre phototherapy and post phototherapy levels of ionized magnesium among the newborns, a mean difference of 0.02 mmol/L was noted with 95% confidence interval of -0.01-0.05 mmol/L. This difference in mean levels of ionized magnesium of newborns before phototherapy and after phototherapy was found to be statistically insignificant with p value of 0.247.

Table 2: Comparison of mean serum magnesium –before and after phototherapy

Variables	Mean values		P value
	Pre phototherapy	Post phototherapy	
Serum Magnesium (mg/dl)	1.81 ±0.15	1.7 ± 0.16	0.651
Ionized Magnesium (mmol/L)	0.34 ± 0.12	0.32 ± 0.11	0.247

DISCUSSION

In a study conducted by Thirupathi et al[17] reported that among the newborns underwent phototherapy the mean birth weight and gestational age was 2.84±0.51 kg and 38.44±1.98 weeks respectively. The mean duration of phototherapy was 37.65±11.06 hours. The incidence of hypocalcemia following the post phototherapy was more among preterm babies and LBW babies than in normal weight babies and term neonates. Mehta et al[18] in their study they assessed the magnesium levels on day one of life and reported that 31% of the neonates had hypomagnesemia on day one and they stated that asymptomatic neonates may have a high prevalence of hypomagnesemia, in their study.

Also, Frargy et al[19] performed a study and reported that they found a difference in relation to magnesium level between the pre phototherapy levels and post phototherapy levels. This difference in reduction of serum magnesium levels before and after the phototherapy was found to be statistically significant, in their study. Also they assessed ionized magnesium levels and they found a reduction in the same after the phototherapy compared to the levels noted before the phototherapy. This difference in reduction of ionized magnesium levels before and after the phototherapy was found to be statistically significant, in their study. Karambin et al[20] performed a study and reported that mean magnesium level was 2.07±0.33 mg/dl before the initiation of phototherapy and 1.81±0.27 mg/dl after the completion of phototherapy. This difference in decrease of serum magnesium levels before and after the phototherapy was found to be statistically significant, in their study.

However, Mazary et al[21] performed a study and reported that higher copper and magnesium levels were reported among the neonates with hyperbilirubinemia than controls compare to the levels reported before and after the intensive phototherapy. They found a positive correlation between the total bilirubin levels and magnesium serum levels, which was found to be statistically significant, in their study. Tehrani et al[22] performed a study and reported that the mean serum magnesium levels was 2.21 mg/dL before the initiation of the phototherapy and the same was found to be 2.06 mg/dL after the completion of phototherapy. This difference in reduction of serum magnesium levels before and after the phototherapy was found to be statistically significant, in their study. Also they concluded that phototherapy could decrease the level of calcium and magnesium levels, based on their findings. Aziz et al[23] performed a study and reported that they found higher serum copper and magnesium levels and lower serum zinc levels in neonates with hyperbilirubinemia than controls. This difference in copper, magnesium and zinc levels among cases with and without hyperbilirubinemia was found to be statistically significant, in their study. Also they found positive correlations between the total bilirubin levels and Mg serum levels, which were found to be significant and negative correlations with Zinc levels, were significantly reported in their study.

In consistent with this study, Gayatri et al[24] conducted a study and reported that they found the mean serum magnesium levels before phototherapy as 2.28±0.29 mg/dl and after the phototherapy as 2.08±0.34 mg/dl in their study. This decrease in serum magnesium levels before and after the phototherapy was found to be statically significant, in their study. Also they stated that there were no statistically significant associations found between the gestational age and birth weight, in their study. Subhashini et al[25] conducted a study and reported that they found a decrease in the level of serum calcium, magnesium, sodium after the phototherapy when compared with the pre phototherapy levels. This decrease in calcium, magnesium and sodium levels, before and after the phototherapy was found to be statistically significant, in their study.

Rania et al[26] conducted a study and reported that different photo therapies have an impact on oxidant/antioxidant balance and are associated with increased oxidative stress

markers with the LED phototherapy being the safest. Raafat et al[27] performed a study and reported that mean serum magnesium level in neonates with hyperbilirubinemia was higher and it was found to be statistically significant. Also mean serum zinc level was lower in neonates with hyperbilirubinemia. On comparing the post phototherapy levels of magnesium and zinc, they found a decrease in magnesium levels and increase in zinc levels. This difference in serum magnesium and zinc levels, before and after the phototherapy was found to be statistically significant, in their study.

Also, Ziba et al[28] in their study they stated that serum magnesium levels were 2.42±0.46 mg/dl before the starting of phototherapy and 2.07±0.32 mg/dl after the completion of phototherapy. This difference in decrease in serum magnesium levels before and after the phototherapy was found to be statistically significant, in their study. Fahimeh et al[29] conducted a study and reported that they could not find any correlation between serum magnesium level and bilirubin in neonates with respect to hyperbilirubinemia. Also in their study they stated serum magnesium level in cases with severe hyperbilirubinemia showed decreased in the serum magnesium levels compare to the cases with moderate hyperbilirubinemia.

CONCLUSION

Without doubts, this study also proved that phototherapy was very effective in reducing the serum total bilirubin levels and direct bilirubin levels. Findings of the present study shows that the serum magnesium levels and ionized magnesium levels were not significantly differ with phototherapy, being given for the treatment of neonatal hyperbilirubinemia. Therefore, it is suggested that further studies be conducted on the effect of phototherapy on the levels of other serum minerals like calcium, zinc and copper on and preterm and term infants.

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