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ORIGINAL RESEARCH

Effect of phototherapy on magnesium level in neonatal hyperbilirubinemia - in a tertiary health care institute

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Abstract –

Background -Neonatal hyperbilirubinemia is defined as the total serum bilirubin level more than 5 mg/dl (i.e., 86 µmol/L).[1] Phototherapy is initial treatment in neonatal indirect hyperbilrubinemia to prevent neurological damage . Hypomagnesemia has been reported as side effect of phototherapy .[11]Hypomagnesmia further may result in serious complications like apnea and neurological side effects.[12,13]

Methods - Objective:Present study aims to estimate the serum Mg^{++} in the term neonates with increased amount of bilirubin in the blood and to compare pre-phototherapy and post-phototherapy serum magnesium level.
Methodology : A prospective hospital based cohort study was conducted on 70 eligible neonates admitted in department of Pediatrics in a tertiary health care institute in North India, conducted from January 2023 to October 2024. After approval of ethical committee, informed consent was obtained from parents of eligible neonates. Serum bilirubin and magnesium measured pre-phototherapy and post-phototherapy to study the effects of phototherapy on serum magnesium.

Results–Our study included 100 neonates with hyperbilirubinemia who received phototherapy, 40 (57.5%) neonates were male and 30 (42.9%) were female. Mean Gestational age was 37.7 +/- 0.84 weeks. Mean birth weight was 2.68 +/- 0.39 kg. 43 (61.42%) neonates were delivered by LSCS and 27 (38.33%) were delivered by NVD. Mean neonatal age was 57.24 +/- 19.96 hours at the time of initiation of phototherapy.The mean pre-phototherapy and Post-Phototherapy magnesium level were 2.16 +/-0.26and1.95 +/- 0.34 respectively and magnesium decreased significantly after 24 hours of phototherapy p value is 0.0001 . No significant correlation was seen while correlating pre-Phototherapy total serum bilirubin and pre-Phototherapy serum magnesium levels.

Conclusion–Serum Magnesium decreased in term babies significantly following 24 hours double surface phototherapy irrespective of gender and birth weight group. Also no co-relation between pre-phototherapy serum magnesium and serum bilirubin level was observed.

Keywords: Neonate,hyperbilirubinemia,phototherapy,magnesium.

Introduction

Neonatal hyperbilirubinemia is defined as the total serum bilirubin level more than 5 mg/dl (i.e., 86 µmol/L).[1] Neonatal jaundice is a common issue that is physiological in most of the cases, howeverhigh levels of bilirubin may result in neurological damage [2-4]

Neonatal hyperbilirubinemia is of two types; Direct (conjugatedhyperbilirubinemia)and indirect hyperbilirubinemia(unconjugated hyperbilirubinemia). Higher level of indirect hyperbilirubinemia is responsible for neurological damage in neonates .[5-8]

Phototherapy is initial treatment in neonatal indirect hyperbilrubinemia to prevent neurological damage . Exchange transfusion is second line modality in neonatal hyperbilirubinemia in case phototherapy is not effective orwith signs of acute bilirubin encephalopathy.[9]

Bilirubin induced toxicity is mediated by N-methyl D – aspartate receptors (NMDA). NMDA is a glutamate receptor and it plays role in synaptic function and memory. Bilirubin, after binding to NMDA receptor

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results in overactivation of receptor, which results in degradation of ion channel complexes in membrane. Neuronal damage in areas of basal ganglia, brainstem nuclei, cerebellum and hippocampus . As magnesium is inhibitor of NMDA receptor, it helps in protection of neuronal damage against hypoxia and hyperbilirubinemia.[10]

The common side effects of phototherapy are hyperthermia, diarrhoea, retinopathy and skin rash etc . Hypomagnesemia has been reported as side effect of phototherapy .[11]Hypomagnesmia further may result in serious complication like apnea and neurological side effects.[12,13] But there are few studies reporting the same in south east Asian population. The present study was undertaken for assessing effects of phototherapy on serum magnesium levels in neonates with Jaundice.

Methods:

Aims & Objective

1.To estimate the amount of Mg^{++} in the serum of infant with increased amount of bilirubin in the blood.

2. To compare the serum magnesium level pre-phototherapy and post-phototherapy

Inclusion criteria

Neonateswith hyperbilirubinemia requiring Phototherapy

Exclusion criteria

1. Neonates with
2. Birth asphyxia
3. Pretermneonate<or=36weeks of gestation
4. Sepsis
5. Infant of diabetic mother
6. Neonates with serum magnesium levels <1.6 mg/dl before Phototherapy Congenital malformations
7. Mothers who received MGSO4 in antenatal period
8. Babies whose parents did not give consent

Method

We conducted a prospective cohort study on 70 eligible neonates admitted in department of Pediatrics MMIMSR, Mullana, a tertiary health care institute in North India, after taking ethical approval from Research Committee, from January 2023 to October 2024 . After taking informed consent from the parents of eligible neonates, detailed history &physical examination performed, serum magnesium level testing was done before initiation of phototherapy and 24 hours of phototherapy treatment for hyperbilirubinemia. Phototherapy was started on the basis of American academy of paediatrics 2017 guidelines .The phototherapy light source was used in form of blue light emitting diodes(LEDs)

Total serum bilirubin was measured by Diazo method which was spectrophotometry and Serum magnesium was measured by colorimetry.

Statistical analysis

Statistical analysis was done using SPSS software version 19.0. Chi-square test and student t test were used for assessment of level of significance.

Result

Our study included 70 neonates with hyperbilirubinemia who received phototherapy. 40 (57.5%) neonates were male and 30 (42.9%) were female. Mean Gestational age was 37.7 +/- 0.84 weeks. Mean birth weight was 2.68 +/- 0.39 kg. 43 (61.42%) neonates were delivered by LSCS and 27 (38.33%) were delivered by NVD. Mean neonatal age was 57.24 +/- 19.96 hours at the time of initiation of phototherapy (table 1).

The mean pre-phototherapy and Post-Phototherapy bilirubin level were 17.79+/-1.72 mg/dl and 10.77 +/- 1.68 mg/dlrespectively and bilirubin decreased significantly after 24 hours of phototherapy with p value of 0.001(table 2).

The mean pre-phototherapy and Post-Phototherapy magnesium Level were 2.16 +/-0.26and1.95 +/- 0.34 respectively and magnesium decreased significantly after 24 hours of phototherapy p value is 0.0001(table 3)

As depicted in table no 2 , pre-phototherapy and post -therapy magnesium level difference is significant in both gender, AGA & SGA neonates, while difference is not significant in LGA neaonates.

No significant correlation was seen while correlating pre-Phototherapy total serum bilirubin and pre-Phototherapy serum magnesium levels (table 4)

Table: 1 Demographic variables :

Variable	Number (%)
Gender	
Male	40 (57.1%)
Female	30 (42.9%)
Mode of Delivery	
NVD	27 (38.58 %)
LSCS	43 (61.42%)
Gestational Age (weeks)	37.7 +/- 0.84 weeks
Neonatal age (days)	57.24 +/- 19.96 hours
Birth weight (Kg)	2.68 +/- 0.39 kg

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Table 2 Comparison of pre-treatment and post-Phototherapy serum bilirubin levels

Serum bilirubin levels (mg/dL)	Pre-treatment	Post-Phototherapy
Mean	**17.79**	**10.77**
SD	**1.72**	**1.68**
P value	**0.001**	

Table 3 Comparison of pre-treatment and post-Phototherapy serum magnesium levels

Serum magnesium levels (mg/dL)	Pre-treatment	Post-Phototherapy
Mean	**2.16**	**1.95**
SD	**0.26**	**0.34**
P value	**0.0001**	

Table 3 Comparison of pre-treatment and post-Phototherapy serum magnesium levels between gender and birth weight groups

Variable	Serum magnesium before phototheraoy	Serum magnesium 24 hours after phototherapy	P value
Girls	2.19 +/- 0.26	2.01 +/- 0.44	0.0038
Boys	2.13 +/- 0.27	1.91 +/- 0.24	0.0012
AGA	2.18 +/- 0.28	1.97 +/- 0.48	0.0041
SGA	2.19 +/- 0.24	1.93 +/- 0.20	0.0001
LGA	1.88	1.77	

Table 4: Correlation of pre-Phototherapy total serum bilirubin and pre- Phototherapy serum magnesium levels

X	r value	p value
Pre-Phototherapy total serum bilirubin and pre-Phototherapy serum magnesium levels	0.0226	0.853 (non-significant)

Discussion

Jaundice manifests as a yellowish tint in the sclera and mucous membranes. Neonatal jaundice ranks among the common causes of morbidity during an infant's first week of life. Magnesium is fourth most abundant cation the body, predominantly stored intracellularly. Maintaining magnesium homeostasis relies significantly on kidney, bone, and gut functions.[14, 15] Phototherapy may cause a reduction in serum magnesium levels which could have significant clinicalimplications.Magnesium potentially plays a neuroprotective role in neonates with hyperbilirubinemia. Administering supplementary magnesium prior to Phototherapy could help in preventing neuronal damage, reduce the risk of kernicterus, and elevate serum magnesium levels. [16,17]

Our study included 70 neonates who received phototherapy for hyperbilirubinemia, 40(57.1%) were male and 30(42.9%) were female with mean gestation age of 37 +/- 0.84 weeks , mean birth weight 2.68 +/- 0.39 kg and mean age at initiation of phototherapy was 57.24 +/- 19.96 hours . 27(38.58%) were delivered via NVD and 43 (61.42%) via LSCS .

The reduction in mean serum bilirubin levels after 24 hours of phototherapy is significant which is similar to study done by Kumar N et al[19] . Similar finding reported in other studies[18,20]. In our study all the included neonates received double surface phototherapy while in study done by Eghbalain[18], Kumar N et al[19], neonates received single surface, double surface and intensive phototherapy.

The average neonatal age recorded was 57.24 hours (equivalent to 2.27 days). In a study by Kumar N et al[19], the mean postnatal age was reported as 5.4 ± 1.3 days, while in another study conducted by Kumar Ret al[22], a similar mean postnatal age of 5.4 ± 1.3 days was observed. [72, 73]This difference can be due to screening method used for hyperbilirubinemia i.e clinical vs transcutaneous bilirubinometer and also variation in individual judgement of skin colour.

A significant proportion of the subjects, 67.14 percent, had neonates with a birth weight equal to or greater than 2.500 Kg, while in the remaining 32.86 percent of cases birth weights ranged from 1.500 Kg (LBW) to 2.499 Kg. The average birthweight was calculated at 2.68 Kg across all participants' neonates in this study's cohort. While other research studies included neonates with average birth weight of approximately 3.000kg [14,19,23] .

Mean pre-treatment and post-Phototherapy total serum bilirubin levels among patients with neonatal Jaundice was 17.79 mg/dL and 10.77 mg/dL. The reduction in total serum bilirubin levels following phototherapy was statistically significant with p value 0.001. It was similar to other studies.[18-22,24]

A significant reduction in the magnesium levels following 24 hours of double surface phototherapy was observed (p value 0.0001). Our results were in concordance with the results obtained by previous

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authors like Frargy MSE [24]et al. Similarly confirmed by other authors. [18-21,23,25]

A significant reduction in the magnesium levels following Phototherapy was seen among patients with AGA & SGA neonates. There is only one baby in our study in LGA group, in which reduction in serum magnesium level following phototherapy was not significant. No previous studies compared serum magnesium level between different birth weight groups.

A significant reduction in the magnesium levels following Phototherapy was seen among both boys and girls. Hence it can be concluded that the alteration in serum magnesium levels after Phototherapy was independent of gender of the neonate. Our results were in concordance with the results obtained by previous authors who also reported similar findings.[20]

No significant correlation was seen while correlating pre-Phototherapy total serum bilirubin and pre-Phototherapy serum magnesium levels . Similarly, Khosravi[26]and colleagues discovered that there was no notable correlation between the severity of jaundice and the level of magnesium in plasma. Similar findings observed by other authors. [27-29]

Conversely, Sarici[30] et al. documented a substantial association specifically between serum magnesium levels and the severity of hyperbilirubinemia in neonates with non-hemolytic jaundice. It was similar to study by Sapkota et al.[25] In our study, we observed only the effect of phototherapy on serum magnesium level rather than comparing the magnesium level between neonates with varied severity of hyperbilirubinemia.

Conclusion

Although drop in serum magnesium level following phototherapy treatment was significant,no neonates developed hypomagnesemia in our study after 24 phototherapy . Delayed effects cannot be concluded as only single measurement post phototherapy was performed. As all the neonates in present study received double surface phototherapy so effects of single surface and intensive phototherapy could not be studied.

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