EFFECT OF DOUBLE SURFACE PHOTOTHERAPY ON SERUM MAGNESIUM LEVELS IN TERM AND LATE PRETERM NEONATES

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ABSTRACT

BACKGROUND

Hyperbilirubinaemia is one of the most common sign encountered in newborns. Untreated, severe unconjugated hyperbilirubinaemia is potentially neurotoxic. Phototherapy is the first line of treatment in neonatal hyperbilirubinaemia. Phototherapy has potential complications like dehydration, electrolyte and haematological changes, etc. Limited studies on magnesium changes after giving phototherapy. Hence, present study to find out magnesium level changes after double surface phototherapy.

MATERIALS AND METHODS

It is a hospital-based prospective comparative study in the Department of Paediatrics in MVJ MC and RH. The study included admitted 30 term and 30 late preterm neonates who are subjected to phototherapy for neonatal hyperbilirubinaemia. Parameters were checked at 0 hours (before starting phototherapy) and after 48 hours of phototherapy. Sample at 0 hours was taken as control group and sample at 48 hours was taken as study group. Comparative study was done between the 2 groups to determine the changes. Results correlated according to duration of phototherapy, weight changes and changes in serum magnesium level.

RESULTS

In term neonates, mean total bilirubin was 15.52 ± 1.081 mg/dL before phototherapy and 9.893 ± 1.042 mg/dL after phototherapy. In late preterm neonates, mean total bilirubin was 15.08 ± 1.128 mg/dL before phototherapy and 9.5 ± 0.841 mg/dL after phototherapy. In term neonates, mean total magnesium was 2.317 ± 0.197 mg/dL before phototherapy and 1.917 ± 0.204 mg/dL after phototherapy. In late preterm neonates, mean total magnesium was 2.513 ± 0.206 mg/dL before phototherapy and 1.923 ± 0.198 mg/dL after phototherapy. The differences were statistically significant. With phototherapy, there was decrease in the bilirubin level as well as magnesium level in both term and preterm neonates.

CONCLUSION

Hyperbilirubinaemia can result in damage to brain and other tissues due to increased bilirubin levels. Phototherapy decreases bilirubin level with simultaneous decrease in magnesium level. Positive correlation present between bilirubin and magnesium level. Neonatologists need to be aware of this situation and consider magnesium supplements, if it is too low.

KEYWORDS

Neonate, Magnesium, Jaundice, Phototherapy, Hyperbilirubinaemia.

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BACKGROUND

Jaundice in newborn is quite common affecting nearly 60% of term and 80% of preterm neonates during first week of life. Hyperbilirubinaemia is one of the most common sign encountered in newborns. The yellow colouration of the skin and sclera in newborns with jaundice is the result of accumulation of unconjugated bilirubin. Untreated, severe unconjugated hyperbilirubinaemia is potentially neurotoxic. Newborns appear jaundiced when the serum bilirubin level is more than 7 mg/dL. Elevated levels of unconjugated bilirubin can lead to bilirubin encephalopathy and subsequently kernicterus with devastating permanent neurodevelopment handicaps. Phototherapy is the first line of treatment in neonatal hyperbilirubinaemia. Phototherapy converts bilirubin to photoisomers that can bypass the liver's conjugating system and be excreted in the bile or in the urine without further metabolism. Phototherapy has potential complications like dehydration, electrolytes and haematological changes. Magnesium is the fourth most abundant cation in the body. It is principally stored intracellularly. It is, however, the extracellular concentrations of the mineral that is of interest to the clinician due to its association with symptoms and signs. The major organs involved in magnesium homeostasis are the gut, bone and kidney, but the regulators affecting these organs at the cellular level are not yet fully understood.

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Hypermagnesaemia is rarest and is observed mostly in those with renal failure and in geriatric and documentation is that there is a positive correlation between plasma ionised Mg levels and severity of hyperbilirubinaemia in newborn.[1,2,3] Phototherapy leads to depression of pineal gland by transcranial illumination resulting in a decrease in melatonin level. Melatonin stimulates secretion of cortisone, which decreases calcium and magnesium absorption leading to hypocalcaemia and hypomagnesaemia. It is suggested that there is a positive correlation between plasma ionised Mg levels and severity of hyperbilirubinaemia in newborn.[4,5,6,7,8] Bilirubin exhibits an affinity for the phospholipids of the plasma membrane, such as the N-Methyl-D-Aspartate (NMDA) receptors. Therefore, it seems that the activation of NMDA receptors may induce neuronal injury, which could be blocked by the antagonists of the NMDA receptors. According to the literature, magnesium is an NMDA antagonist, which could decrease the neurotoxic effects of bilirubin.[9] Limited studies are there on changes in serum magnesium levels after phototherapy. Hence, the present study to find out serum magnesium level changes after giving double surface phototherapy.

Aims and Objectives

To study the effect of double surface phototherapy on serum magnesium after significant exposure of 48 hours in cases of neonatal jaundice in term and late preterm neonates.

To study if any clinical effect of serum magnesium level changes after giving double surface phototherapy.

METHODS AND MATERIALS

It was a hospital-based prospective comparative study done in the Department of Paediatrics in MVJ MC and RH.

The study included admitted term and late preterm neonates who were subjected to phototherapy for neonatal hyperbilirubinaemia.

Inclusion Criteria

- All term and late preterm neonates (born at or after 34 weeks of gestation) subjected to double surface phototherapy based on clinical/laboratory criteria.
- Exclusive breastfed neonates.

Exclusion Criteria

- Neonates on IV fluid, total parental nutrition and mechanical ventilator.
- Neonates on medication for other morbidities.
- Neonates undergone exchange transfusion.
- Phototherapy given for less than 48 hours.

Methodology- Study included 30 term and 30 late preterm neonates, parameters were checked at 0 hour (before starting phototherapy) and after 48 hours of phototherapy. Sample at 0 hour - Control. Sample at 8 hours - Test comparative study was done between these groups to determine changes.

Results correlated according to duration of phototherapy, weight changes and changes in serum magnesium level.

Investigations

Complete blood count.
Blood group and typing of mother and infant.
Total bilirubin, direct bilirubin and indirect bilirubin.
Total serum magnesium.

Statistical Data Analysis

All data were tabulated and statistically analysed using suitable statistical tests (paired t-test) 'p' value <0.05 was considered moderately significant, while 'p' value <0.01 as strongly significant.

OBSERVATION AND RESULTS

The results of the study are organised in a tabulated form mean gestational age and mean birth weight were also taken into account. Changes in bilirubin level and magnesium level in both term and late preterm neonates are recorded and statistically analysed.

Gestational Age	Term Neonates, n=30	Late Preterm Neonates, n=30	P Value
Mean ± SD	38.843 ± 1.030 weeks	35.763± 0.685 weeks	<0.0001, highly significant

Table 1. Gestational Age

Birth Weight	Term Neonates, n=30	Late Preterm Neonates, n=30	P Value
Mean ± SD	2.7313± 0.2433 kg	2.4053± 0.1749 kg	<0.0001, highly significant

Table 2. Birth Weight

Total Bilirubin	Before Phototherapy, n=30	After Phototherapy, n=30	P Value
Mean ± SD	15.52 ± 1.081 mg/dL	9.893 ± 1.042 mg/dL	<0.0001, highly significant

Table 3. Bilirubin Changes in Term Neonates After Phototherapy

Total Bilirubin	Before Phototherapy, n=30	After Phototherapy, n=30	P Value
Mean ± SD	15.08 ± 1.128 mg/dL	9.5 ± 0.841 mg/dL	<0.0001, highly significant

Table 4. Bilirubin Changes in Late Preterm Neonates After Phototherapy

Total Magnesium	Before Phototherapy, n=30	After Phototherapy, n=30	P Value
Mean ± SD	2.317 ± 0.197 mg/dL	1.917 ± 0.204 mg/dL	<0.0001, highly significant

Table 5. Magnesium Changes in Term Neonates After Phototherapy

Total Magnesium	Before Phototherapy, n=30	After Phototherapy, n=30	P Value
Mean ± SD	2.513 ± 0.206 mg/dL	1.923 ± 0.198 mg/dL	<0.0001, highly significant

Table 6. Magnesium Changes in Late Preterm Neonates After Phototherapy

The mean gestational age in term neonates was 38.843 ± 1.030 weeks, while that in late preterm neonates was 35.763 ± 0.685 weeks.

The mean birth weight in term neonates was 2.7313 ± 0.2433 kg, while that in late preterm neonates was 2.4053 ± 0.1749 kg.

In term neonates, mean total bilirubin was 15.52 ± 1.081 mg/dL before phototherapy and 9.893 ± 1.042 mg/dL after phototherapy.

The difference was statistically significant.

In late preterm neonates, mean total bilirubin was 15.08 ± 1.128 mg/dL before phototherapy and 9.5 ± 0.841 mg/dL after phototherapy.

The difference was statistically significant.

In term neonates, mean total magnesium was 2.317 ± 0.197 mg/dL before phototherapy and 1.917 ± 0.204 mg/dL after phototherapy.

The difference was statistically significant.

In late preterm neonates, mean total magnesium was 2.513 ± 0.206 mg/dL before phototherapy and 1.923 ± 0.198 mg/dL after phototherapy.

The difference was statistically significant.

With phototherapy, there was decrease in the bilirubin level as well as magnesium level in both term and late preterm neonates. The decrease in bilirubin level as well magnesium level were statistically significant in both term and late preterm neonates change in values between term and late preterm is negligible.

DISCUSSION

Jaundice has a high incidence rate in newborn in first week of life. 85% of all newborn develop jaundice. A serum bilirubin level >15 mg/dL is found in 3% of term newborn. Jaundice is seen in newborn due to immaturity of liver, short RBC's life span, increased enterohepatic circulation and decreased level of UDP.[10] Hyperbilirubinaemia is a very common problem encountered by neonatologists and paediatricians in early neonatal period in both term and preterm newborns. Serum bilirubin levels are usually 1-3 mg/dL at the time of birth and rise at the rate of <5 mg/dL/day peaking at 2-3 days in term neonates.[10] Phototherapy is the primary modality of treatment for infants with high levels of bilirubin. Phototherapy is a very safe and effective mode of management with minimal potential adverse effects, if appropriate precautions are taken. There is no evidence, which is suggestive of any long-term adverse effects of phototherapy. Our study showed that there were statistically highly significant difference in serum bilirubin level as well as magnesium level before starting phototherapy and after 48 hours of phototherapy in term and late preterm neonates. Several other studies have concluded in similar inference as our study. Sarici et al concluded that there is a positive correlation between ionised Mg and the severity of hyperbilirubinaemia in full-term newborns with neonatal hyperbilirubinaemia Mehta et al concluded that extremely preterm infants even without additional exposure tocolytic magnesium are at risk for the lower pH associated elevation of ionised Mg, which should be considered during the management of these infants in order to prevent hypermagnesaemia-related pathology.[4] Bhat et al found that postnatal magnesium sulfate treatment improves neurologic outcomes at discharge for term neonates with severe perinatal asphyxia.[5] Gathwala et al found that postnatal magnesium sulfate treatment with its neuroprotective action prevents brain injury from bilirubin toxicity.[6] Mohsen et al concluded that phototherapy decrease serum Mg level as it decrease serum bilirubin and there is a positive relation between serum bilirubin and serum Mg levels.[8] Hamed et al inferred phototherapy decrease serum Mg level as it decreases serum bilirubin and there is a positive relation between serum bilirubin and serum Mg levels.[11] Khosravi et al concluded that phototherapy decreases the total magnesium concentration and magnesium administration will prevent bilirubin neurotoxicity in icteric neonates.[12] Tuncer et al reported lower serum total Mg concentrations in umbilical cord as well as maternal blood of neonates with jaundice as compared to normal neonates and they inferred that hypomagnesaemia may result from intracellular shift of Mg ions.[13] However, Pintov et al in their study on the predictive value of Zn, Mg and Cu levels of cord blood on the development of benign hyperbilirubinaemia have concluded that the cord serum concentrations of Cu are not helpful in predicting, which neonate are at risk of developing hyperbilirubinaemia. This can be explained by the fact that Cu and Mg levels maybe increased after haemolysis, hence cord blood cannot be a good indicator or predictor.[14]

CONCLUSION

Hyperbilirubinaemia can result in damage to brain and other tissues due to increased bilirubin levels. This results in a compensatory increase in magnesium levels to counter the effects of high bilirubin levels. Phototherapy decreases bilirubin level with simultaneous decrease in magnesium level. There is a positive relation between serum bilirubin and serum magnesium levels.

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