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EFFECT OF PHOTOTHERAPY ON SERUM ELECTROLYTE LEVELS IN NEONATAL HYPERBILIRUBINEMIA

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ABSTRACT

Introduction: Neonatal hyperbilirubinemia is the most common clinical morbidity noted during the first seven days following birth. Amongst all the modalities available for management of neonatal hyperbilirubinemia, phototherapy is proven to be the safest. However, like any other intervention, phototherapy too has some of its own side effects. **Aims & objective:** This study aimed to investigate the effect of phototherapy on serum electrolyte levels in neonates admitted to neonatal intensive care unit with the diagnosis of neonatal hyperbilirubinemia. **Material and methods:** Demographic profiles, laboratory findings, and electrolyte levels before phototherapy and 48-72 hours after phototherapy of 290 patients hospitalized with neonatal hyperbilirubinemia between Sep 2020 and March 2022 were compared in this retrospective study. **Results:** The mean sodium level significantly decreased from 141.3 mg/dL to 140.1 mg/dL after phototherapy. The decrease in potassium level was not statistically significant. The mean calcium level significantly decreased from 10.02 mg/dL to 9.68 mg/dL after receiving phototherapy. **Conclusion:** The level of serum electrolytes in newborns may change with phototherapy. Serum sodium and calcium levels may decrease after phototherapy. For prevention of possible adverse effects, the changes in electrolyte levels should be considered in the clinical course of newborns receiving phototherapy and appropriate fluid-electrolyte treatments should be given

Introduction

Neonatal hyperbilirubinemia or jaundice is defined as the yellowish discoloration of the skin. It is seen in more than 60% of term and 80% of preterm babies in the first week of life [1,2]. It is more often physiological; however, sometimes serum bilirubin levels cross the normal range and criterion (as per the recommended guidelines by the American Academy of Paediatrics [AAP] to become pathological[3,4].Some of the most common causes of neonatal jaundice include physiological jaundice, breast feeding jaundice, breast milk jaundice, prematurity leading to jaundice & various pathological causes like hemolytic disease, neonatal sepsis, deficiency of G6PD enzyme, hypothyroidism, cephalhematoma and rare conditions such as Gilbert's syndrome, liver dysfunction etc[5,6].In the treatment of hyperbilirubinemia, the aim is to reduce the high bilirubin levels. Phototherapy has been used worldwide as the main therapy for this purpose [7]. Phototherapy provides rapid oxidative reactions and allows the formation of urine-inducible mutant bilirubin isomers by intermolecular rearrangement [8,9]. The most common side effects associated with phototherapy include bronze baby syndrome, skin rash, dehydration, diarrhea, hemolysis, skin burns, retinal damage, and lactose intolerance [10]. Less common side effects that are more prominent in premature cases es include hypocalcemia; riboflavin deficiency; a decrease in levels of luteinizing hormone, follicle-stimulating hormone, and growth hormone; gonadal damage; the suppression of immune system; and a decrease in cardiac pulse[10-14]. The aim of this study was to investigate the effect of phototherapy on electrolyte levels in hospitalized infants with jaundice in the neonatal intensive care unit (NICU).

Material and methods

Place of study: The study was conducted in a teaching hospital in Jammu.

Study Design: Hospital based retrospective study

Duration of study: 18 months (Sep 2020 and March 2022)

Aims:

1. To determine the level of sodium, potassium, calcium and bilirubin in serum.
2. To compare the levels before and after phototherapy in full term neonates with hyperbilirubinemia.

Method of study: Neonates that were born in the hospital over a period of 18 months who developed clinical jaundice requiring investigation or treatment were enrolled in the study. This was a retrospective study and all demographic and clinical data were obtained from all the medical records. The levels of electrolytes were checked at 0 hour (the first sample during the admission to NICU) and at 48-72 hours after the cessation of phototherapy (at the first routine follow-up after discharge). A comparative study was carried out between these two groups of samples to determine changes in the levels of electrolytes. All the medical records were noted including age of onset of jaundice, sex, gestation age whether term or preterm/IUGR, investigations performed like serum bilirubin (done by Diazo method via fully automated analyzer), CBC, CRP, serum TSH, ABO/RH, G6PD, direct Coombs test and treatment received were also noted down.

Inclusion criteria:

Healthy term neonates with unconjugated hyperbilirubinemia who are > 37 weeks of gestation requiring phototherapy more than 24 hours.

Exclusion criteria:

a. Gestation age <37 completed weeks
b. Babies with major congenital malformations, sepsis, undergoing exchange transfusion
c. Neonates on intravenous fluids
d. Neonates with deranged electrolytes at the time of initiation of phototherapy
e. New-borns who expired or were referred before complete evaluation during the period of hospital stay.
f. Conjugated hyperbilirubinemia (conjugated bilirubin> 2mg/dl).

Statistical analyses Quantitative data was expressed as mean, standard deviation, and median, while categorical data was presented as frequency and percentage. Levels of serum electrolytes before and after phototherapy with the baseline data of all study subjects was recorded in a predesigned Proforma and master chart was prepared in Microsoft Excel sheet.

Analysis of the data was done using SPSS 20 (Statistical Package for Social Sciences). Each electrolyte (sodium,

potassium and calcium) was analyzed separately. Paired-t-test was used to compare pre and post patient's electrolyte levels. p-value of <0.001 is significant and p<0.0001 is considered highly significant

Results

A total of 290 neonates were enrolled in the study and 92(52%) were males and 88 (48%) were females. No statistically significant difference was observed in terms of gender.

From the study population, most of the babies 188 (64.48%) were born by caesarian section. The mean gestational age was 38.7±0.76 weeks, and the mean maternal age was 27.8±5.58 years while the mean age at the admission was 134.77±44.5 hours The mean birth weight was 31346±257g. The mean duration of phototherapy was 36.47±2.8. The mean total serum bilirubin levels at the admission and during discharge were 16.9 mg/dL and 8.6 mg/dL, respectively. None of the cases required advanced therapies such as intravenous immunoglobulin (IVIG) and blood exchange. Baseline characteristics of all the subjects are represented in the tabulated form (Table 1). After phototherapy, the mean sodium level decreased from 141.3 mmol/L to 140.1 mmol/L, which was statistically significant (p<0.0001) Although the mean potassium level decreased from 4.39 mmol/L to 4.25 mmol/L, this difference was not significant (p=0.02). The mean calcium level decreased from 10.02 mg/dL to 9.68 mg/dL, and the difference was statistically significant (p<0.0001) shown in Table 2.

Table 1: Baseline characteristics of babies with neonatal jaundice

Parameters	N=290
Caesarian born	188(64.48%)
Gestational age	38.7±0.76 weeks
Mean maternal age	27.8±5.58 years
Mean age at admission	134.77±44.5 hours
Mean birth weight	31346±257 g
Mean duration of phototherapy	36.47±2.8
Mean total bilirubin at admission	16.9mg/dl
Mean total bilirubin on discharge	8.6mg/dl

Table 2. Comparison of electrolytes level before and after phototherapy

	Before PT*	After PT*	p
Serum Sodium	141.3±3.14	140.1±3.01	<0.0001**
Serum Potassium	4.39±0.56	4.25±0.86	0.02
Serum Calcium	10.02±0.06	9.68±0.85	<0.0001**

*Values are given as mean ±Standard Deviation
Where P<0.001 is statistically significant
**P<0.0001 is highly significant
PT: Phototherapy

DISCUSSION

Phototherapy has been accepted as the most widely used treatment for neonatal jaundice, and there are various phototherapy delivering methods. The phototherapy efficiency relies on the light source's peak wavelength, the irradiance and the surface area of the body exposed, and the distance between the infant and the light source.[15-16] Phototherapy, like any other treatment, has adverse effects. Unlike other side effects, there are currently just a few studies that depict the negative impact of phototherapy on serum electrolytes. A few recent researches have focused on the occurrence of hypocalcemia as a result of phototherapy. The goal of this research was to determine the changes in serum electrolytes in newborns that were undergoing PT for neonatal jaundice in NICU. The study measured serum electrolytes in 290 jaundiced term newborns before and after PT in this study. The study compared how often PT-induced electrolyte abnormalities occurred in each one of them. We found that serum sodium and calcium were decreased significantly after phototherapy in neonates. Although serum potassium also decreased after phototherapy but the difference was statistically insignificant.

Before PT, the mean serum sodium was 141.3±2.69 mmol/L and after PT, the mean serum sodium was 140.5 ± 2.70 mmol/L. Serum sodium level was found to be decreased significantly after PT (p=0.0001) in the study. This decline was proposed to be due to reduced gastrointestinal absorption of sodium because of diarrhea and also generous frequent feeding ensured in our institution in these babies. Similar results were recorded in other studies [17-19].

In the study, mean serum potassium was 4.39 ± 0.45 mEq/L before PT and was 4.25 ± 0.65 mEq/L after PT. The decline in serum potassium level was found to be not statistically significant after PT (p=0.02). However, this decline was marginal with levels close to near normal range in all the cases. The results are in accordance with other studies[20] (p-value 0.45 s).

The serum calcium levels before PT were 10.02 ±0.06 and 9.68±0.85 after PT with p value <0.0001 which was statistically significant. Calcium is required for a variety of biochemical processes, including cell enzymatic and secretory activity, blood coagulation, cell membrane integrity and function and neuromuscular excitability[25]. In hypocalcemia, the cell's sodium permeability is increased and the cell membrane's excitability is increased. Hyperreflexia, apnea, cyanosis, vomiting, seizures, tachypnea, stridor or laryngospasm, increased extensor tone, jitteriness, and clonus are common non-specific symptoms. However, some may also present with tachycardia, prolongation of QTc interval (>0.45 s), and even heart failure but these symptoms suggestive of cardiac involvement are relatively less observed. Various studies showed 75%, 66.6% and 56% of term newborns had hypocalcemia was seen following PT respectively[21-24]. PT inhibits melatonin production by the pineal gland [25]. As a result, corticosterone's impact on bone calcium is reduced. Because melatonin levels drop during PT, the level of corticosterone in the blood also drops. As a result, reduced corticosterone reduces bone resorption, resulting in hypocalcemia. Hypocalcemia was produced by a decrease in parathormone production in jaundiced newborns treated with PT[23]. In all the studies described above, statistically significant decline in the levels of total serum calcium was asserted but this decline is of little clinical importance in majority.

Conclusions:

This study documented that a decline in the levels of serum sodium, potassium and calcium levels in infants exposed to PT. However, these changes were not clinically significant.

Statistically significant decline was noted in serum sodium and serum calcium but none of the baby exhibited any clinical manifestation since only marginal change was observed.

The duration of phototherapy significantly affects the serum electrolytes. Hence, continuous follow-up and efforts to shorten/minimize the duration should be considered a high-priority during management of neonatal hyperbilirubinemia.

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