

## Original Research Article

# Study of sodium and potassium changes in term neonates receiving phototherapy

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## ABSTRACT

**Background:** Neonatal Hyperbilirubinemia (NH) is the commonest abnormal physical finding during the first week of life and also the most common cause for readmission during the early neonatal period is a cause of concern for the parents as well as for the Pediatricians. Hence appropriate management of Neonatal Hyperbilirubinemia is of paramount importance. Phototherapy plays a significant role in prevention and treatment of hyperbilirubinemia. However, this treatment modality may itself result in inherent complications. The present study was carried out with the objective of evaluating the sodium and potassium changes in neonates receiving phototherapy for neonatal hyperbilirubinemia.

**Methods:** A prospective hospital based observational comparative study conducted on 96 eligible term neonates admitted in the neonatal intensive care unit receiving phototherapy at a teaching Hospital from October 1<sup>st</sup> to December 31<sup>st</sup> 2018. A predesigned proforma has aided the enrolment of new-borns into the study according to AAP guidelines. Serum bilirubin, sodium and potassium were determined before and after termination of phototherapy. The first samples were considered as controls. A comparative study was made between before and after phototherapy groups to determine the incidence of sodium and potassium changes.

**Results:** The study group included 96 term neonates that were managed with phototherapy. Incidence of low birth weight babies was 21.9%. Mean birth weight and gestational age was  $2.76 \pm 0.38$  kg and of  $38.34 \pm 0.88$  weeks respectively. Mean duration of phototherapy was  $38.48 \pm 09.34$  hours. The incidence of Sodium and potassium changes were found to be statistically significant after phototherapy ( $p < 0.01$ ) but neonates didn't develop any signs of hyponatremia and hypokalemia.

**Conclusions:** The study shows that neonates undergoing phototherapy are at a higher risk of sodium and potassium changes. This risk is greater in LBW babies and hence this group of babies should be closely monitored for changes in sodium, potassium and should be managed accordingly.

**Keywords:** Neonatal hyperbilirubinemia, Phototherapy, Potassium, Sodium

## INTRODUCTION

Neonatal hyperbilirubinemia (NH) is the commonest abnormal physical finding during the first week of life.

Over two third of newborn babies develop clinical jaundice. The physical finding like yellowish discoloration of the skin and sclera in newborns is due to accumulation of unconjugated bilirubin. In most infants, unconjugated hyperbilirubinemia reflects a normal

physiological phenomenon.<sup>1</sup> Neonatal hyperbilirubinemia nearly affects 60% of term and 80% of preterm neonates during first week of life.<sup>2</sup>

Nevertheless untreated, severe unconjugated hyperbilirubinemia is potentially neurotoxic and conjugated hyperbilirubinemia is a harbinger of underlying serious illness. Neonatal hyperbilirubinemia is a reflection of liver's immature excretory pathway for bilirubin and is the most common reason for readmission of neonates in first week of life in current era of postnatal discharge from hospital.<sup>3</sup> Neonatal hyperbilirubinemia is a cause of concern for the parents as well as for the pediatricians.

Premature babies have much higher incidence of neonatal jaundice requiring therapeutic intervention than term neonates. Hyperbilirubinemia was found to be the most common morbidity (65%) among 137 extremely low birth weight neonates born over a period of 7 years in AIIMS.<sup>4</sup>

Elevated levels of unconjugated bilirubin can lead to bilirubin encephalopathy and subsequently kernicterus, with devastating permanent neurodevelopment handicaps. Conjugated hyperbilirubinemia indicates potentially serious hepatic disorders or systemic illnesses. Hence appropriate management of neonatal hyperbilirubinemia is of paramount importance.

Hyperbilirubinemia can be treated either by phototherapy or exchange transfusion or pharmacologic agents. Phototherapy plays a significant role in prevention and treatment of hyperbilirubinemia.

The main demonstrated value of phototherapy is that it reduces the need for exchange transfusion. As any treatment has its side effects, phototherapy also has its adverse effects like electrolyte changes, hyperthermia, feed intolerance, loose stools, skin rashes, bronze baby syndrome, retinal changes, dehydration, hypocalcemia, redistribution of blood flow and genotoxicity.<sup>5,6</sup>

Unlike other side effects a very few studies are currently available that depicts the adverse effects of phototherapy on serum sodium and potassium. One of the side effects of phototherapy is diarrhea.

As diarrhea can lead to electrolyte changes, and as hypocalcemia is already a known fact, present study is hereby intended to study the serum sodium and potassium changes due to phototherapy.

## METHODS

This study was a prospective hospital based comparative study conducted on term neonates admitted in the neonatal intensive care unit receiving phototherapy in SSMCH, Tumkur, Karnataka from October 1<sup>st</sup> to December 31<sup>st</sup> 2018.

## Inclusion criteria

- Full term neonates (37 completed weeks to 41 weeks) with unconjugated hyperbilirubinemia requiring phototherapy.

## Exclusion criteria

- New-borns with perinatal asphyxia, whose mother had history of taking Anti-convulsant, newborns fed with cow's milk, born to a diabetic mother, with onset of jaundice within 24 hours of age, who had exchange transfusion, with jaundice lasting more than 14 days of life, with sepsis and neonates developed sepsis while receiving phototherapy, babies born with apparent major congenital anomalies, Rh and ABO incompatibility, neonates with conjugated hyperbilirubinemia were excluded from the study.

Written informed consent was taken from parents/guardians of all eligible subjects in their preferred language. Complete maternal history was taken and maternal risk factors like hypertension, diabetes mellitus, oligohydramnios, anemia, epilepsy, fever, any rash, any drug intake during pregnancy other than iron and folic acid supplementation were ruled out. Complete history and physical examination were carried out in all neonates included in the study. Demographic and clinical variables were recorded. It included birth weight, sex, gestational age, mode of delivery, age of appearance of icterus, maternal blood group and Rh status, baby blood group and Rh status, anthropometric measurements (weight, length and head circumference) of infant at the time of admission and duration of phototherapy.

Total and indirect serum bilirubin, serum sodium and potassium were checked at 0 hour (first sample) and at 48 hours of phototherapy or at discontinuation of phototherapy (second sample) whichever is earlier were recorded. The first sample was considered as control. Venous blood samples were collected from the neonates and sent for total bilirubin, direct bilirubin, electrolytes, and blood group. Total and direct bilirubin is measured by Diazo method; electrolytes (Na, K) by autoanalyser Erba EM 200 machine. Blood group of newborns was analyzed by antisera method.

## Statistical analysis

The collected data was analyzed using SPSS 16 software. Continuous variables were presented as mean and standard deviation of the mean (SD), while categorical variables are presented as number and percentage. Chi square test was used to know the association between different variables. P value < 0.05 was considered statistically significant. All data of various groups were tabulated and statistically analyzed using suitable statistical tests (student's t test).

## RESULTS

The study group included 96 neonates, 50 male babies and 46 female babies, with mean gestational age of  $38.34 \pm 0.88$  weeks and mean birth weight of  $2.76 \pm 0.38$  kilograms. out of 96 neonates 21 (21.9%) were low birth weight babies and 75 (78.1%) were normal birth weight babies. 26 neonates were delivered by normal vaginal delivery and 70 by lower segment caesarean section. Mean time of appearance of icterus was  $104.60 \pm 48.10$  hours. Mean duration of phototherapy was  $38.48 \pm 09.34$  hours respectively. Table 1 shows sex of study group, out of 96 term neonates 50 were male and 46 were female babies. Table 2 shows weight of neonates, out of 96 neonates 75 were of normal birth weight and 21 were low birth weight babies.

**Table 1: Sex of study group.**

Sex	Male	Female	Total
Number	50 (52.08%)	46 (47.92%)	96 (100%)

**Table 2: Weight of neonates.**

Weight	<2.5kg	2.5 to 4kg	Total
Number	21(21.9%)	75 (78.1%)	96

**Table 3: Correlation of post phototherapy serum sodium with birth weight.**

Sodium levels	LBW	Normal	Chi square and p value
<135	01(50%)	01(50%)	0.945<0.01
135-145	20 (21.3%)	74 (78.7%)	
Total	21 (21.9%)	75 (78.1%)	

**Table 6: Comparative evaluation of study variables pre and post phototherapy in neonates.**

	Pre	Post	Difference	T value	P value
Total bilirubin	$16.13 \pm 2.34$	$9.32 \pm 1.99$	6.81	34.11	<0.01
Ind bilirubin	$13.85 \pm 2.53$	$7.72 \pm 2.05$	6.12	29.33	<0.01
Sodium	$140.57 \pm 2.68$	$137.56 \pm 2.55$	2.31	12.77	<0.01
Potassium	$4.45 \pm 0.68$	$4.13 \pm 0.56$	0.32	2.67	<0.01

Table 6 shows changes in total bilirubin, indirect bilirubin, sodium, potassium before and after phototherapy. Even though none of term neonates in present study developed signs of hyponatremia and hypokalemia, Sodium and potassium changes were significant in babies after 48 hours of phototherapy.

The P value obtained was <0.01 Thus, it is considered to be statistically significant. Overall, there was significant decline in serum sodium and potassium along with total bilirubin following 48 hours of phototherapy.

Table 3 shows following phototherapy 2 babies out of 96 showed serum sodium levels less than 135m Eq/L and 94 babies showed serum sodium levels between 135-145m Eq/L.

**Table 4: Correlation of post phototherapy serum potassium with birth weight.**

Potassium levels	LBW	Normal	Chi square and p value
3.5-5.5	20	74	0.238<0.01
>5.5	1	1	
Total	21 (22.0%)	75 (78%)	

Table 4 shows following phototherapy 2 babies out of 96 showed serum potassium levels more than 5.5 m Eq/L and 94 babies showed serum potassium levels between 3.5 to 5.5 m Eq/L.

**Table 5: Correlation of post PT serum electrolytes with duration of phototherapy.**

	24 hours	48 hours	Total
<b>Sodium</b>			
<135	0	2 (100%)	02
>135	32	62	94
<b>Potassium</b>			
3.5-5.5	33	61	94
>5.5	0	2	02

Table 5 shows the mean duration of phototherapy was  $38.48 \pm 09.34$  hours number of neonates who received phototherapy for 48 hours (63 neonates) as compared to neonates who received phototherapy for 24 hours (33 neonates).

## DISCUSSION

Neonatal hyperbilirubinemia (NH) is the commonest abnormal physical finding during the first week of life. Early discharge of healthy term newborns from the hospital after delivery has recently become a common practice for medical, social and economic reasons. However, it has been shown that newborns whose post-delivery hospital stay <72 hours are at a significantly greater risk for readmission than those whose stay is >72 hours. Phototherapy has emerged as the most widely used

form of treatment and is the current therapy of choice to reduce severity of neonatal unconjugated hyperbilirubinemia. As any treatment has its side effects, phototherapy also has. Few studies are currently available that depicts the adverse effects of phototherapy on serum electrolytes. A few studies in the recent past, have stressed on the incidence of hypocalcemia following phototherapy and very few studies till date regarding the effect of phototherapy on sodium and potassium are done. Hence present study was designed to determine the sodium and potassium changes in neonates receiving phototherapy for neonatal jaundice. Hyponatremia, a very common electrolyte abnormality, is a serum sodium level  $<135$  mEq/L. Both total body sodium and total body water determine the serum sodium concentration. Hyponatremia exists when the ratio of water to sodium is increased. This condition can occur with low, normal, or high levels of body sodium. Similarly, body water can be low, normal, or high. Hypokalemia is defined as serum potassium level below 3.5 mEq/L. Curtis MD et al, studied diarrhea in jaundiced neonates treated with phototherapy. Study showed that absorption of sodium, chloride and potassium was significantly impaired in the patients receiving phototherapy.<sup>7</sup> Beresford D et al and Conolly G et al, stated that babies under phototherapy can have sodium imbalances due to insufficient fluid replacements.<sup>8</sup> The differential effect of other electrolytes with phototherapy has not been studied by other workers except that for Curtis MD et al, study which stated that absorption of water, sodium chloride, and potassium was significantly impaired in the patients receiving phototherapy.<sup>7</sup> Tan KL et al, study in healthy full-term neonates demonstrated a transient raise in potassium levels after phototherapy which was in contrast to present study.<sup>9</sup> Reddy AT et al, study showed sodium changes are significant, potassium and chloride changes were insignificant which is in contrast to present study where both sodium and potassium changes are significant.<sup>10</sup> It is evident that in the present study phototherapy induced sodium and potassium changes was more in term LBW babies but the actual relationship in these babies with phototherapy has to be evaluated with larger sample studies.

## CONCLUSION

There was a significant reduction in the level of serum sodium and potassium when phototherapy given for 48 hours, but the risk of hyponatremia and hypokalemia is low in healthy full-term neonates with normal birth weight. Frequency of sodium and potassium changes following phototherapy is higher when the duration of phototherapy is more. The risk is greater in LBW babies

and hence this group of babies should be closely monitored for changes in sodium and potassium should be managed accordingly.

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