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Serum Electrolyte Changes in Neonates Receiving Phototherapy for Hyperbilirubinemia A Prospective Comparative Study

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ABSTRACT

Background: The use of phototherapy is crucial in the management of hyperbilirubinemia. However, phototherapy can have side effects like hyperthermia, feed intolerance, loose stools, skin rashes, bronze baby syndrome, changes in the retina, dehydration, and hypocalcaemia. Present study aimed to assess and correlate the electrolyte disturbance with phototherapy among newborn with hyperbilirubinemia.

Material and Methods: Neonates weighing more than 2500g at delivery and more than 35 weeks gestation were included in the current prospective cross-sectional study. The newborns were placed into two groups Group 1:- Newborns with jaundice receiving phototherapy and Group 2:- Newborns matched for group-1 babies not requiring phototherapy. Data like age, parity of the mother, significant illness and treatment received during antenatal period were recorded. Gestational age, mode of delivery, Apgar score, sex, birth weight and type of feeding were recorded. Serum bilirubin, calcium and electrolytes were estimated at recruitment and at 24 hrs after initiating phototherapy. Neonates were monitored till discharge and all clinical findings were recorded. The data were entered into an excel file. SPSS v21 running on Windows 10 was used to analyse the data, and a p-value of <0.05 was taken as statistically significant.

Results: There were 231 babies in total, of which 48.3% were boys and 41.7% were girls. At 72 hours of life, the newborn's mean potassium and serum calcium levels were found to be considerably lower than those of the control group (p 0.05). Following phototherapy, the newborn's mean changes in serum sodium, potassium, chloride, and calcium were much lower than before. (p<0.05)

Conclusion: Present study documents a significant electrolyte derangement in newborns receiving phototherapy.

Keywords: Newborns, Neonatal hyperbilirubinemia, Phototherapy, Serum electrolytes.

INTRODUCTION

During the first week of life, neonatal hyperbilirubinemia has been the most often observed clinical condition[1]. Paediatricians and parents are both concerned about neonatal hyperbilirubinemia (NH), which is a frequent reason for readmission during the early neonatal period.[2]

High amounts of unconjugated bilirubin may result in bilirubin encephalopathy, which may progress to kernicterus and would impair neurological development permanently. In both the prevention and treatment of hyperbilirubinemia, phototherapy is important. However, using this mode of therapy could have its own

adverse effects,[3,4] like hyperthermia/hypothermia, feed intolerance, loose stools, skin rashes, bronze baby syndrome, retinal damage, dehydration, and hypocalcemia.[5,6]

The result of the study will be used to predict changes in serum electrolyte levels in relation to duration of phototherapy and jaundice severity. This in turn will help in improving the management of infants receiving phototherapy.

MATERIAL AND METHODS

This Prospective cross- sectional comparative study which was conducted after getting institutional ethical clearance from November 2020 to August 2022. This study included neonates who were >35 wks of gestation and birth weight of >2.5 kgs. The study excluded neonates with congenital abnormalities, direct hyperbilirubinemia, severe anaemia, perinatal asphyxia, and those requiring exchange transfusion.

Baby's age, sex, gestational age, birth weight, jaundice history in the family, and day of jaundice onset were evaluated. Icterus- severity were assessed clinically using Kramer's rule. Two ml of Venous blood sample was collected for serum bilirubin, calcium and serum electrolytes at recruitment and 24 hours after phototherapy. Babies were followed up daily till discharge (Cases). While gathering samples for a regular newborn screening, two millilitres of venous blood from controls were drawn to measure serum electrolytes and calcium at 72 hours of life. The serum electrolytes of cases at requirement later were compared with sample taken after 24 hours of phototherapy. The serum electrolyte levels of cases and control were compared.

RESULTS

In present study, total of 231 newborns fulfilling inclusion criteria were included. Among them 48.3% were male and 41.7% were female newborn. There were 154 control newborns and 77 cases. There was no significant difference between the groups regarding gender, mode of delivery and mean weight ($p>0.05$) (Table 1).

The baseline electrolytes were measured among the cases at recruitment and found to be within the normal limits. At 72hrs, the electrolyte measurements were compared between the groups. When compared to the control group, the cases were found to have significantly lower mean potassium and serum calcium levels (p 0.05). Additionally, the serum sodium and chloride levels were significantly lower among cases (Table 2).

After 48 hours of phototherapy, there was a statistically significant mean change in the newborn's serum levels of sodium, potassium, chloride, and calcium ($p<0.05$) (**Table 3**).

Table 1: Baseline characteristics of cases and controls

Baseline characteristics		**Cases n=77**	**Controls n=154**	**p-value**
Sex	Female	36	83	1.183
	Male	41	71	

Mode of delivery	NVD	19	53	2.033
	LSCS	58	101	

Table 2: Comparison of the mean level of electrolytes between cases and controls at 72hr sample

Electrolytes in 72hrs sample	**Controls n=154**		**Cases n=77**		**p-value**
	Mean	**SD**	**Mean**	**SD**	
Sodium mmol/L	138.76	4.88	137.60	4.83	0.117
Potassium mmol/L	4.40	.41	4.03	.47	0.01*
Chloride mmol/L	104.25	3.74	103.75	4.27	0.402
Calcium mg/dl	9.03	.74	7.83	.86	0.01*

Table 3: Changes in mean level of electrolytes among cases at 72hr compared to baseline 48hr sample.

	48 hrs sample		**72 hrs sample**		**p-value**
	Mean	**SD**	**Mean**	**SD**	
Sodium mmol/l	142.73	3.433	137.60	4.833	0.01
Potassium mmol/l	4.178	.591	4.075	.466	0.05
Chloride mmol/l	106.95	4.644	103.75	4.265	0.01
Calcium mg/dl	9.20	.670	7.71	.904	0.01

DISCUSSION

Neonatal hyperbilirubinemia is treated with phototherapy, which also includes side effects such as hyperthermia, feed intolerance, loose stools, skin rashes, bronze baby syndrome, retinal damage, dehydration, and hypocalcemia. There aren't much research out there right now that show how phototherapy affects serum electrolytes. Following phototherapy, 30% of preterm neonates and 20% of full-term neonates experience hypocalcemia.[5]

The changes in electrolyte values following phototherapy can be due to additional factors as well. It is important to understand the electrolyte changes during the neonatal period before coming to a conclusion that phototherapy alone induces the same. Very few studies are available in the literature. As a result, we sought to compare the changes in blood sodium, potassium, chloride, and calcium in neonates undergoing phototherapy for jaundice with those of matched normal newborns.

Similar to the current study, Kumar et al reported that 6% of patients experienced hyponatremia following phototherapy, which was higher in low birth weight (LBW) patients (17.2%, p<0.001) and preterm neonates (17.6%, p<0.001) than in normal weight patients (2.6%) and term neonates (3.1%). When

phototherapy continued longer than 48 hours, electrolyte changes were observed in 17.4% of infants ($p<0.001$). Following phototherapy, a statistically significant drop in mean serum sodium levels was also discovered.[7,8]

Blood levels of Na, K, Ca, BUN, and Cr were demonstrated to significantly decrease with phototherapy duration ($p<0.001$). The duration of phototherapy has a significant favourable relationship with blood glucose levels. All forms of phototherapy showed a deleterious impact on the Na, K, BUN, Cr, and Ca levels after 48 hours. Serum electrolytes shown to decrease during phototherapy. These alterations were influenced by the duration of phototherapy. The type of phototherapy had no impact on the levels of serum potassium.[9,10]

Goyal et al. found that newborns in the study group had significantly lower total serum calcium levels (0.94–0.49 mg/dl) following phototherapy. Ionized serum calcium decreased in the study group after phototherapy (0.560.36 mg/dl), which was statistically significant ($p<0.001$). Hypocalcemia was recorded in 9.6% of infants, with preterm infants more likely to have it (11.7%) than term neonates (8.5%). A newborn who was born preterm or who is ill should have their serum calcium levels checked before receiving phototherapy. In babies receiving phototherapy, preventive oral calcium supplementation may be explored because phototherapy results in hypocalcemia.[11]

According to studies by Rangaswamy et al., infants receiving phototherapy are more likely to experience alterations in sodium and potassium levels. Because this risk factor is higher in LBW babies, it is important to constantly monitor these babies for changes in sodium and potassium levels and to manage them properly.[3]

Neonates exposed to phototherapy are more likely to develop electrolyte imbalances. As a result, such newborns must be closely monitored to avoid imbalances and their negative repercussions.[12,13,14.]

CONCLUSION

Present study documents a significant electrolyte derangement in newborns receiving phototherapy. Following phototherapy there is significant lowering in the level of sodium, potassium, chloride and calcium among the newborns. Also compared to controls, there was significant hypokalemia and hypocalcemia among cases in the study. With the findings of this study, we recommend measurement of electrolytes in newborns during and after the phototherapy.

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