Original Article

The effect of head covering in prevention of phototherapy-induced hypocalcemia in icterus newborns with gestational age less than 35 weeks

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Abstract

Background: Hypocalcemia is one of the complications of phototherapy resulted from influence of phototherapy in melatonin secretion reducing corticosterone and ultimately increasing bone uptake. In this study, effect of head covering in prevention of this common and serious complication is studied.

Materials and Methods: This prospective, randomized clinical trial study conducted on premature infants with gestational age <35 weeks with jaundice. Infants were divided into two groups ($n = 43$). The first group (intervention group) and the second group (control group) while on the cut, underwent phototherapy using four blue fluorescent lamps in distance of 35 cm. Eyes and genitalia were protected using appropriate clothing. In the first group, head was covered using cloth helmet with a suitable size. For both groups, serum calcium was measured before and 36 h after starting phototherapy.

Results: Mean serum calcium before phototherapy in both intervention and control groups was 8.72 ± 1.12 and 8.79 ± 0.87 mg/dL, respectively, and the difference between groups was not significant ($P = 0.76$). After treatment, calcium level in both intervention and control groups was 8.9 ± 0.82 and 8.43 ± 0.91, respectively, and the difference between the two groups was significant ($P = 0.015$). Mean serum calcium levels after phototherapy in the intervention group was −0.17 ± 1.46 (increase) and it was 0.35 ± 0.71 (decrease) in the control group. According to *t*-test, the difference between the two groups was significant ($P = 0.036$).

Conclusion: Head covering during phototherapy probably prevents from hypocalcemia.

Key Words: Hypocalcemia, jaundice, neonatal, phototherapy

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INTRODUCTION

Jaundice refers to accumulation of yellow bilirubin pigments in the skin and sclera, and it is one of the most common findings in the neonatal period. It has been reported that 60% of neonates and 80% of preterm infants are with jaundice in the first week of life[1] which, if untreated, can cause acute and chronic encephalopathy in high levels of bilirubin.[2] In the 1950s, phototherapy was introduced as a noninvasive method for the treatment of hyperbilirubinemia[3] and in 1985, National Institute of Child Health and Human Development reported that phototherapy is effective as blood transfusions in preventing neurological complications of hyperbilirubinemia.[4]

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Although phototherapy is used widely as a noninvasive method for treatment of infants with hyperbilirubinemia,[5,6] it is associated with such complications as fever, dehydration, loose stools, erythematous rash, damage to retinal cells, and changes in blood flow to mesenteric.[5-8]

Hypocalcemia is one of the complications which have been recently considered, and phototherapy-induced hypocalcemia has been approved in various studies.[9-12] Under normal acid and base conditions and also in conditions where serum albumin is normal, total serum calcium level and its ionization are exactly related, and exact status of disorders related to calcium can be obtained by measurement of total calcium. Normal levels of calcium in a premature infant can range from 8 to 10.6 mg/dL. Values <8 mg/dL are considered hypocalcemia.[10,11] Considering symptoms of hypocalcemia in many cases has differential diagnosis with other disorders such as neonatal sepsis and may be premature infants are placed under unnecessary antibiotics due to electrolyte imbalance such as hypocalcemia; on the other hand, hypocalcemia is associated with severe symptoms including jitteriness, lethargy, apnea, and seizures. In this study, effect of head covering in prevention of this relatively common and serious complication is studied. In case of having preventive effect, it not only reduces the unnecessary tests and treatment but also reduces the severe complications of hypocalcemia as well.

MATERIALS AND METHODS

This study is a prospective, randomized clinical trial that was conducted on premature infants with gestational age <35 weeks with jaundice which needed phototherapy and was hospitalized in Beheshti Hospital affiliated to Isfahan University of Medical Sciences since summer 2014 to winter 2014.

Inclusion criteria included preterm infants with gestational age <35 weeks with jaundice who needed phototherapy, lack of congenital malformations at birth, the infant's mother did not suffer from gestational diabetes or hyperparathyroidism, the infant's mother did not take anticonvulsive drugs during pregnancy, and lack of prenatal asphyxia. Apgar score of 5 min <3 and umbilical cord pH and bicarbonate <7 and 12, respectively,[5] the infant was not treated with sodium bicarbonate, infants were not with sepsis and intrauterine growth restriction. Infants were randomly assigned using random number table into two groups. With confidence level 95% and test power 80%, sample size was obtained in each group of 43. In the first group, the head was covered by cloth during phototherapy while phototherapy was done without head covering in the second group, and sampling was done using total counting until needed sample in each group was achieved. Prior to initiation of the study, written consent was taken from the parents.

In this study, 86 preterm infants with jaundice who needed phototherapy and had inclusion criteria were selected and divided into two groups (n = 43). Age and gender were controlled in both groups. The first group (intervention group) and the second group (control group) while on cut, underwent phototherapy using four fluorescent lamps in the blue color in distance of 35 cm. Eyes and genitalia were protected using appropriate clothing, including eye blind and diapers. Head was covered using cloth helmet with a suitable size only in the first group (intervention group). Total serum calcium was measured before phototherapy and 36 h after initiation of phototherapy in both groups. The specialized assistant filled the questionnaire with above items daily and collected necessary information. Total calcium below 8 mg/dL was considered hypocalcemia in both groups.[5]

Data collection and analysis

With confidence level 95% and test power 80%, sample size was obtained in each group of 43. At the end, data were collected in one checklist and analyzed by statistical software using independent t-test, Pearson correlation test, and Chi-square test.

RESULTS

Table 1 gives distribution of demographic and general variables in both groups. In terms of t-test, the mean age, weight, and duration of phototherapy were not significantly different. In addition, according to the Chi-square test, sex distribution was similar in both groups.

The mean serum bilirubin level before phototherapy in both intervention and control groups was 10 ± 2.53 and 10.3 ± 2.71 mg/dL, respectively, and there was no significant difference between the two

Table 1: Distribution of age, gender, and duration of phototherapy in both groups

Variables	Groups		
	With cover	Without cover	*P*
Gestational age (weeks)	30.26±3.3	31.02±2.94	0.26
Weight (g)	1789±364.8	1515.5±396.7	0.63
Sex, *n* (%)			
Male	23 (53.5)	20 (46.5)	0.52
Female	20 (46.5)	23 (53.5)	
Duration of phototherapy	63.62±11.27	57.91±18.14	0.08

groups ($P = 0.58$). The mean serum levels of bilirubin level after phototherapy in two groups was 7.38 ± 1.81 and 7.4 ± 2.21 mg/dL, respectively, and the difference between the two groups was not significant ($P = 0.97$).

The mean value of hyperbilirubinemia after phototherapy in the intervention group was 2.59 ± 1.54 and it was 2.91 ± 2.04 mg/dL in control group, and the difference between groups was not significant ($P = 0.42$). Further, in terms of *t*-paired test, bilirubin levels after treatment compared to before were significantly reduced ($P < 0.001$) in both intervention and control groups. Variance analysis test with repetition of observations on data showed phototherapy was accompanied by significant reduction of bilirubin in both groups, and no significant difference between two groups was observed in intervention and control groups ($P = 0.51$). Among variables of age, weight, and gender of the infants and duration of phototherapy, duration of phototherapy had significant effect on changes in the level of bilirubin ($P = 0.044$).

Mean serum calcium before phototherapy in both intervention and control groups was 8.72 ± 1.12 and 8.79 ± 0.87 mg/dL, and the difference between the two groups was not significant ($P = 0.76$). After treatment, calcium level in intervention and control group reached to 8.9 ± 0.82 and 8.43 ± 0.91, and difference between two groups was significant ($P = 0.015$). Mean serum calcium difference after phototherapy was –0.17 ± 1.46 in intervention group (increase) and it was 0.35 ± 0.71 in control group (decrease), and the difference between two groups was significant according to *t*-test ($P = 0.036$). In addition, according to *t*-paired test, changes in serum calcium in the intervention group was not significant ($P = 0.44$), but in the control group, serum calcium decreased significantly ($P = 0.002$). Repeated measures ANOVA showed head covering prevented from reduction of serum calcium and significant difference between calcium level before and after phototherapy was observed ($P = 0.63$). Results are given in Table 2. It should be noted that following phototherapy only one patient in covering-free group suffered from decreased levels of calcium.

According to the results obtained, there is reverse correlation between the level of bilirubin and serum calcium as reverse as –0.21 which was not statistically significant ($P = 0.051$), but after treatment, a significant inverse correlation was observed between the two as –0.23 ($P = 0.037$) [Figures 1 and 2].

Table 2: The mean serum bilirubin and calcium in both groups before and after treatment

Variables	Groups		
	With cover	Without cover	*P* between*
Bilirubin			
Before	10±2.53	10.3±2.71	0.58
After	7.38±1.81	7.4±2.21	0.97
Difference	2.59±1.54	2.91±2.04	0.42
P within**	<0.001	<0.001	0.63***
Calcium			
Before	8.72±1.12	8.79±0.87	0.76
After	8.9±0.82	8.43±0.91	0.015
Difference	−0.17±1.46	0.35±0.71	0.036
P within**	0.44	0.002	0.63***

*Significant level between the two groups based on independent sample *t*-test, **Significant level between before and after in each group based on paired sample *t*-test

DISCUSSION

The current study was done aiming at effect of head coverage covering in prevention of phototherapy-induced hypocalcemia in premature infants with gestational age <35 weeks with jaundice. According to the obtained results, head covering during phototherapy had no impact on changes in the level of serum bilirubin, but serum calcium levels in the exposed group, under phototherapy, had significantly declined, and this decline was dependent also duration of phototherapy while no reduction in serum calcium levels was observed in the group with head covering. On the other hand, significant reverse correlation was observed between bilirubin and serum calcium levels after treatment, and it can estimate that covering head of infants during phototherapy probably prevents from incidence of hypocalcemia in infants. Of course, such conclusion was also obtained in other studies so that in the study by Sethi *et al*., it was shown that over 90% of preterm infants and 75% of term infants suffer from hypocalcemia after phototherapy.[12] Medhat in Cairo University indicated 75% of neonates and 90% of preterm infants who received phototherapy developed hypocalcemia.[13] In the study by Jain *et al*., it was found that 55% of preterm infants and 30% of neonatal infants developed hypocalcemia after phototherapy. In this research, preterm infants who were hypocalcemic, 63.6% had jitteriness and 97.6% of them irritability. Among the term neonates with hypocalcemia, 50% of them had jitteriness and 16.7% of them had irritability, and since most infants were symptomatic newborns, prophylactic administration of calcium was proposed in neonates under phototherapy for prevention of hypocalcemia. Furthermore, in this research, it was shown that the incidence of hypocalcemia is greater

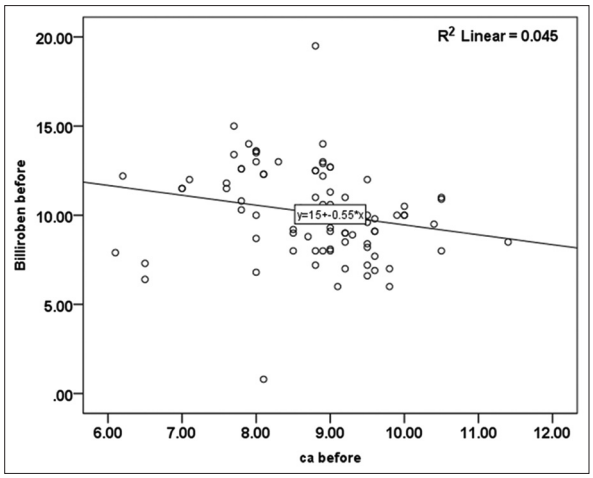

Figure 1: Correlation between bilirubin and calcium levels before treatment

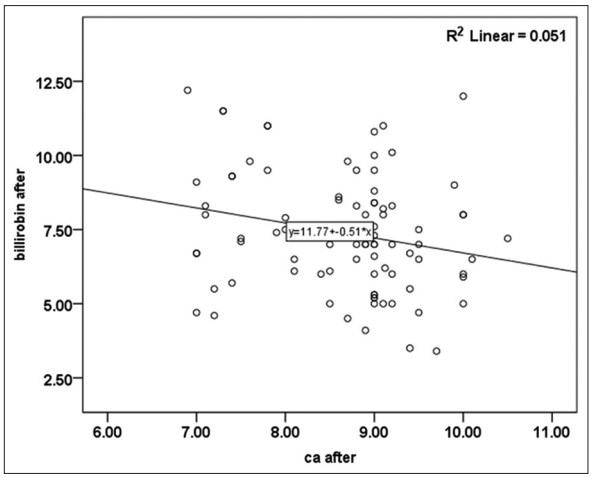

Figure 2: Correlation between bilirubin and calcium levels after treatment

at higher levels of bilirubin.[14] In the study by Kumar *et al*., 80% of preterm and 66.6% term neonates were with hypocalcemia while the control group did not report any cases of hypocalcemia. Among preterm infants with hypocalcemia, 50% had jitteriness, 25% had irritation, and 25% had lethargy, but none of them developed seizures and apnea. Among term neonates, 80% were symptomatic and 30% had jitteriness, 20% had irritation, 30% had lethargy, and none of them developed seizures and apnea.[15] Gutcher and Odell specified a relationship between hypocalcemia and phototherapy.[16] Karamifar *et al*. in their study in Shiraz showed 22% of preterm infants and 8.7% of term infants developed hypocalcemia after phototherapy, but in this research, no infant developed symptomatic hypocalcemia and hypocalcemia was eliminated after phototherapy.[17] Eghbalian and Monsef in Hamadan studied 63 term infants above 2500 g under phototherapy and indicated incidence of hypocalcemia in infants under phototherapy was significantly higher than case group.[18] In the study by Ehsanipoor *et al*. in Shahid Akbarabadi Hospital, it was found that 82% of infants developed hypocalcemia after phototherapy.[19]

CONCLUSION AND RECOMMENDATIONS

Considering obtained results, it can be concluded that head covering during phototherapy probably prevents from hypocalcemia in preterm infants <35 gestational weeks and since Hypocalcemia can be associated with complications as jitteriness, lethargy, and seizures, it is recommended during phototherapy.

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Conflicts of interest
There are no conflicts of interest.

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