

## The Effect of Phototherapy Duration on Serum Level of Total Calcium and 25-hydroxy vitamin D (25(OH) D) in Jaundiced Neonates

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**Background:** Neonatal jaundice is a common clinical phenomenon that requires a doctor and gets a diagnosis and medical treatment. The aim of this study was to evaluate the effect duration of phototherapy on Vitamin D, Bilirubin and Total Serum Calcium in jaundiced neonates.

**Objectives:** To compare the dynamic postural control among CAI and healthy asymptomatic participants using star excursion balance test (SEBT) and to compare the reach distance of injured dominant and injured non-dominant limb among CAI participants

**Materials and Methods:** This study was conducted on 100 infants with physiological jaundice worsened. The blood samples were taken before and 24, 48 and 72 hours after phototherapy. The levels of Vitamin D, Bilirubin and Calcium were checked. Collected data analyzed by statistical methods in SPSS.19.

**Results:** 57% of neonates were boy and rests of them were girl with mean age of 6.8 days. Vitamin D levels in newborns in baseline, 24, 48 and 72 hours after phototherapy were 9.34, 9.52, 10.20 and 10.50 ng/dl, respectively. Calcium levels in baseline, 24, 48 and 72 hours after phototherapy were calculated 9.43, 9.16, 8.88 and 8.35 mg/dl, respectively that this reduction was statistically significant. Bilirubin levels at baseline, 24, 48 and 72 hours after phototherapy were also calculated 17.29, 15.53, 12.78 and 10.89, respectively; that this reduction was statistically significant

**Conclusion:** The results showed that phototherapy duration can cause a significant reduction in the levels of Calcium and Bilirubin but does not significantly effect on the levels of vitamin D.

**Key words:** Vitamin D, Bilirubin, Phototherapy, Neonatal Jaundice



## INTRODUCTION

Jaundice is one of the most prevalent clinical diseases in neonates, which approximately occur in 50% of term and 80% of pre-term neonates.<sup>1</sup> It usually develops 2-4 days after birth, and is spontaneously recovered within 1-3 weeks. Most neonatal jaundices originate from an increased breakdown of Red Blood Cells (RBC) and decreasing in the excretion of Bilirubin.<sup>2-3</sup> Phototherapy is one of the common treatment method for diagnosis hyperbilirubin in neonates.<sup>4-5</sup> it seems to be safe, but several studies have reported some side-effects such as skin rash, diarrhea, increase in body temperature, dehydration, damage to DNA, trembles, damage to eyes, nose obstruction due to eye bandage, tanned child syndrome, and hypocalcaemia.<sup>6-7</sup> Also, a few studies revealed that phototherapy can induces a decrease in total and ionized calcium in neonates, which may happen simultaneously with increase urinary excretion of calcium.<sup>8</sup>

Few studies have mentioned that phototherapy as a risk factor for Hypocalcaemia.<sup>9</sup> Vitamin D deficiency can cause a disorder in calcium and phosphor metabolism and adverse effects such as rickets in children, Osteomalacia in adults and impaired growth.<sup>10</sup> Few studies have shown that phototherapy may increase UV rate received by the neonate and effect on the serum level of vitamin D.<sup>11</sup> The present study aimed at investigating the occurred changes in vitamin D , Bilirubin and serum Calcium level in jaundiced neonates treated with phototherapy.

## MATERIALS AND METHODS

This is a cross-sectional study that has been done on 100 neonates with non-pathologic jaundice admitted to Bu-Ali hospital in Ardabil city for phototherapy.

Prior to phototherapy, 2 cc of blood sample were taken from subjects, and then bilirubin, 25(OH) D, and calcium levels were checked. For Vitamin D tests we used kit (ELFA, VIDAS BRAHMS PCT kit, bioMerieux SA, France). The subjects were then treated with phototherapy under blue light with a wavelength of 420-470 nm in 8-lamped tunnel at a distance of 30-40 centimeters from body level in the 1st,

2nd, and 3rd days. The total length of time for phototherapy was 24 hours, because of child nutrition and breastfeeding about 15-30 min in each 8 hour (three time in a day) we cut phototherapy. At the end of the 1st, 2nd, and 3rd days after the onset of phototherapy, a second blood sample was taken to examine calcium, vitamin D and bilirubin levels. Collected data were analyzed using statistical methods such as t-tests and chi-square in SPSS.19. Significance level was set at less than 0.05.

## Statistical Analysis

Statistical analysis was done using SPSS 16.0 version software for windows. The descriptive analysis was used to find the mean and standard deviation. Intra group analysis of injured and uninjured limb reach distances of the CAI group and right and left limb reach distances of the control group were done using pair t-test. ANOVA (post hoc Tukey test) was further performed for comparison of injured, uninjured and control averaged SEBT reach distances.

Independent t-test was used to compare the reach distances of injured dominant and injured non-dominant. The level of significance was set at 95% ( $p=0.05$ ) for all the observations. Clinical meaningful difference in the reach distances between injured and uninjured of CAI participants, left and right limb of control participants and dominant injured and non-dominant injured limb; and among injured, uninjured and control reach distances was calculated for effect size (Cohen's d and Eta squared).

## RESULTS

Of the neonates, 57% were boy and the rest were girl. The mean age and the mean weight of subjects were  $6.8 \pm 3.3$  days, and  $2.97 \pm 0.47$  Kg, respectively. The results indicated that vitamin D level increased with the rise of light reception duration, but the increase was not statistically significant. (Table 1)

**Table.1.** Change pattern of Vitamin D level by time

Time	Mean	SD	p-value
Start time	9.34	4.45	0.582
24 hour late	9.52	4.7	
48 hour late	10.2	3.36	
72 hour	10.5	2.63	

late			
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The results revealed that the levels of Calcium had a significant decrease with the increase of light reception duration. (Table 2)

In the present study, 7 neonates (7%) in start of study, 17 neonates(17.5%) after 24 hours, 23 neonates (29.5%) after 48 hours, and 9 (34.6%) after 72 hours after phototherapy receive, developed hypocalcaemia.

**Table.2.** Change pattern of Calcium level by time

Time	Mean	SD	p-value
Start time	9.43	0.83	0.001
24 hour late	9.16	1.04	
48 hour late	8.88	1.1	
72 hour late	8.35	0.9	

Results showed that with an increase in light reception duration, the levels of Bilirubin was significantly decreased. (Table 3)

**Table.3.** Change pattern of Bilirubin level by time

Time	Mean	SD	p-value
Start time	17.29	2.79	0.001
24 hour late	15.53	3.31	
48 hour late	12.78	3.28	
72 hour late	10.89	1.18	

There was no significant difference in level of Vitamin D, Bilirubin, and Calcium between two sexes. There was no significant relationship between the levels of Calcium and Vitamin D in different times and neonates' weight. The results disclosed that there was a direct relationship between neonates' weight and bilirubin level, because with increase of neonates' weight the level of Bilirubin was significantly decreased. However, the study failed to find any significant relationship between the level of Vitamin D and duration of phototherapy. (P=0.582).

## DISCUSSION

One adverse effect of phototherapy is hypocalcaemia whose exact mechanism is still unknown. It might be attributed to a decrease in

melatonin level following phototherapy or an increase in intestinal prystaltysm and deficiency in its absorption.<sup>12</sup>

In the present study, the levels of Calcium at baseline, 24, 48, and 72 hours following phototherapy were respectively 9.43, 9.16, 8.88, and 8.35 mg/dl and this decrease of calcium level was statistically significant (P=0.001). Furthermore, in the start of phototherapy, 7 neonates (7%) developed hypocalcaemia. In Houman et al research, the mean serum levels of Calcium were 9, 8.65, and 18.7 mg/dl, at the onset, 24 and 48 hours after phototherapy, respectively. Their showed that neonates treated with phototherapy were at the risk of hypocalcaemia, and the mean level of serum calcium decreased during the phototherapy of premature neonates.<sup>13</sup> Karami-far et al in study showed regarding hypocalcaemia, manifested that serum calcium level of neonates had a significant difference between premature and term neonates in the first day, after 48 hours, and the day following phototherapy. Usually in the most neonates with hypocalcaemia, serum calcium returned to its normal level, 24 hours after stopping phototherapy. Also, study revealed that neonates treated with phototherapy were highly prone to hypocalcaemia, and this risk was higher in premature neonates.<sup>14</sup>

Behjati et al. found that the mean calcium level was 8.96 and 8.6 before and 72 hours after phototherapy. They showed that 26 neonates (13%) developed hypocalcaemia and the reduction in Calcium level after phototherapy was statistically significant (P=0.005).<sup>15</sup> Mutlu et al. in a study measured Calcium level and showed that 15% of neonates developed hypocalcaemia, with regard to the development of hypocalcaemia, they found a significant difference between neonates without hats (77.8%) and those with hats (22.2%).<sup>16</sup> Kumar et al. found no significance difference in serum calcium level between term and pre-term neonates, but they found a significant decrease in calcium level in 66.6% of term and 80% of premature neonates 48 hours after the onset of phototherapy but such difference was not observed in control group.<sup>17</sup> Sethi et al. in study revealed that, 90% of premature and 75% of term neonates developed hypocalcaemia after phototherapy. They found a significant decrease

in total and ionized calcium in the experimental group in comparison to the control group.<sup>18</sup> Likewise, Ali-zadeh et al. in a study reported that 56% of neonates experienced a fall in calcium level which was statistically significant ( $P=0.03$ ), and 7% developed hypocalcaemia.<sup>12</sup> Similarly, Romagnoli et al.'s study confirmed that phototherapy can lead to a significant decrease in calcium level. Therefore, in summary it can be concluded that phototherapy, with unclear mechanisms, can lead to a decline in calcium level and consequently in hypocalcaemia, but it is obscured whether it can cause symptomatic hypocalcaemia or not.<sup>9</sup>

In the present study, the levels of vitamin D rise from 9.34 in baseline to 10.5 ng/dl at 72 hours after phototherapy, but the increase wasn't statistically significant ( $P=0.582$ ). In Gillis et al.'s study<sup>19</sup> Vitamin D level was measured in the first day and 48 hours after performing phototherapy and they found no significant change in vitamin D level after 48 hours compare to baseline. Accordingly, it was concluded that phototherapy cannot stimulate biosynthesis of vitamin D. Likewise, in Dan-lerodiconou et al.'s<sup>20</sup> research the difference between serum level of vitamin D before phototherapy and 48 hours after its end was not significant. ( $P=0.384$ ) However, Mutlu et al.<sup>16</sup> reported that the difference in vitamin D level between neonates with hyperbilirubinemia and healthy neonates was statistically significant ( $P=0.01$ ). The results of our study correspond to findings of Gillis<sup>19</sup> and Dan-lerodiconou's studies.<sup>20</sup> In the present study, phototherapy was performed with wavelengths of 420-470 nm, because of maximum vitamin D production in UVB wavelengths, i.e. 280-320 nm, it is likely that the wavelength used in the present investigation did not effect on vitamin D production.

## CONCLUSION

The present study confirms that phototherapy can lead to a significant decrease in calcium level and, thus, increase the risk of hypocalcaemia in neonates; whereas, it cannot significantly increase the level of Vitamin D. Some limitations of the present study are that it failed to measure maternal level of vitamin D and examine hypocalcaemia symptoms in neonates. It is highly recommended that serum

calcium level to be investigated over neonates treated with phototherapy for over 48 hours. Future research may also address hypocalcaemia symptoms in neonates on the basis of serum calcium level.

## CONFLICTS OF INTEREST

None declared

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