EFFECT OF HEAD COVERING ON HYPOCALCAEMIA RESULTING FROM PHOTOTHERAPY IN FULL TERM NEONATES WITH HYPERBILIRUBINEMIA

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ABSTRACT

Objective: To compare the frequency of hypocalcaemia with or without covering the heads of full term icteric neonates during phototherapy.

Study Design: Randomized controlled trial.

Place and Duration of Study: Neonatal intensive care unit of Paediatric department, Pakistan Navalship Shifa Hospital, Karachi from Jan 2017 to Jun 2017.

Methodology: One hundred and four full term neonates undergoing phototherapy for hyperbilirubinemia were divided in two equal groups. In study group heads were covered with a cap. Levels of serum bilirubin and serum calcium were measured before starting the phototherapy and after 48 hours of phototherapy. Data was collected and analyzed with SPSS 16.0.

Results: Among 104 neonates included in study, 47 (45.2%) neonates were males and 57 (54.8%) were females. Their mean age was 5.02 ± 2.14 days and mean weight was 3.01 ± 0.322 kg. Hypocalcemia occurred in 22 (21.2%) neonates out of 104. In control group 14 neonates developed hypocalcemia and in case group 8 neonates developed hypocalcemia. None of the neonate had symptomatic hypocalcemia. Chi square test resulted in a *p*-value of 0.23. This value is more than 0.05 so it is not significant.

Conclusion: In our study less no of neonates with covered heads developed hypocalcemia as compared to neonates whose heads were not covered. But these results were statistically not significant. However previously done studies in other countries showed significant results with covered heads. So we suggest that large multicenter study should be conducted in our country to find out exact significance.

Keywords: Head covering, Hyperbilirubinemia, Hypocalcaemia, Neonatal jaundice, Phototherapy.

INTRODUCTION

It is common among neonates to develop jaundice during the initial days of their life. It has been reported that 55.2% full term neonates are affected by jaundice globally[1]. A study was conducted in Pakistan which stated that in a neonatal centre in Karachi 27.6% of the infants presented with jaundice[2]. In another study conducted in Swat this incidence was calculated as 36.54%[3]. In most of the cases high levels of bilirubin are benign but in small number of neonates, it may lead to acute hyperbilirubin encephalopathy which can further cause kernicterus. In the developed countries 0.5 to 1.3 neonates per 100,000 live births present with kernicterus[4] while in the developing countries 3% of all neonates admitted to hospital are affected by this problem[5].

These serious consequences of hyperbilirubinemia can be prevented by early identification and aggressive treatment. Mainly these neonates are treated with phototherapy and few require exchange transfusion. Aim of these treatments is to reduce the unconjugated bilirubin to a non-toxic level. Exchange transfusion requirement is reduced with new and better phototherapy equipment and improved techniques[6,7].

Phototherapy is an easy and simple process but it also has few complications such as hyperthermia, rash, diarrhoea, dehydration, DNA insult, damage to retina, syndrome of bronze baby, patent ductus arteriosus in preterm infants and decreased calcium levels. If hypocalcaemia persists in infants it can result in convulsion,

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apnoea and tetany. It also has few long-term implications including physical disability, mental retardation and educational failure.

Bone uptake of calcium is increased by cortisol which induces hypocalcaemia. Effect of cortisol on bones is blocked by melatonin which is secreted from pineal gland. During phototherapy pineal secretion of melatonin is inhibited and effect of cortisol is unopposed which results in hypocalcemia[8,9]. Intravenous calcium is suggested by some researchers to prevent hypocalcaemia during phototherapy but in neonates its rapid infusion may result in cardiac arrest or hypotension. So some other methods should also be explored to prevent this hypocalcaemia.

A study was conducted in Iran in which they proposed that by covering the heads of neonates during phototherapy hypocalcaemia can be prevented. They concluded at the end of study that frequency of hypocalcaemia was less in study group (covered heads) (13.88%) than control group (uncovered heads) (38.88%)[10]. To our knowledge not much work has been done in Pakistan on this topic. If by covering the heads of neonates during phototherapy hypocalcaemia is prevented, we will not only apply this strategy in our neonatal unit but it will also be advocated to other hospitals to save babies from phototherapy induced hypocalcaemia.

Operational Definitions

Neonate: Age: 0 to 28 days of life.

Hypocalcaemia: It is defined as total serum calcium <1.9mmol/L in neonates of age 0-10 days and total serum calcium <2.25mmol/L in neonates of age >10 days measured at 48 hours after start of phototherapy.

Hyperbilirubinemia:

- Serum total bilirubin levels on
- Day one >188µmol/L
- Day two >257µmol/L
- Day three >306µmol/L and
- From day four onwards >342µmol/L was considered as hyperbilirubinemia.

METHODOLOGY

This randomized controlled trial was conducted in neonatal intensive care unit of Paediatric department, Pakistan Navalship Shifa Hospital Karachi, from Jan 2017 to Jun 2017. Sample size was calculated from frequency of hypocalcaemia described in study conducted in Iran[10]. In this study frequency of hypocalcaemia was 13.88% in case group while 38.88% in control group. Hypothesis testing two sample proportionsone sided test was used by software Sample Size version 2.0. Power is 90% and significance level is 5%. Sample size calculated was 52 in each group. Total sample size was 104 neonates. Consecutive (non probability) sampling technique was used.

Neonates having gestational age >37 weeks, weight >2.5 kg, normal serum calcium levels and hyperbilirubinemia (as in operational definition) were included in study. Neonates who had history or evidence of asphyxia, sepsis, exchange transfusion, haemolytic anaemia and hypothyroidism were excluded because all these conditions can result in altered serum calcium levels.

After ethics review committee of the hospital gave approval for the study, neonates were evaluated according to inclusion and exclusion criteria. Parents were explained the study and written informed consent was taken from them. Computer generated codes were placed in envelops and were used to randomly divide full term healthy neonates into two groups. Stockinet cap was used to cover the heads of neonates in one group (case group) while in the other group heads were not covered and were exposed (control group) during phototherapy. Before initiating the phototherapy data including gender, weight, serum total bilirubin level and serum calcium level was noted. Hemolytic anemia was ruled out by complete blood picture and reticulocyte count and sepsis was ruled out by C-reactive protein. Routine phototherapy was instituted with 4 lamps, 40 watts, blue light with a wave length of 420-470 nanometers. These lamps were kept at a distance of 40 cm from the neonate. After 48 hours of

phototherapy serum calcium level and serum total bilirubin level were measured again.

Obtained data was analyzed with the help of SPSS version 16.0. Frequencies and percentages were calculated for qualitative variables like gender and frequency of hypocalcaemia and for quantitative variables like age, calcium and bilirubin levels. Effect modifiers the age and the gender were controlled by stratification. Post stratification chi-square test was applied. A *p*-value ≤0.05 was considered to be significant.

Table-I: Demographic data of patients.

		Control	Case
Gender	Male	22	25
	Female	30	27
Age (Days)		4.76 ± 1.84	5.28 ± 2.39
Weight (Kg)		2.99 ± 0.35	3.02 ± 0.29

RESULTS

This study included 104 term neonates who presented with hyperbilirubinemia. 47 (45.2%) neonates were males and 57 (54.8%) were females. Their mean age was 5.02 ± 2.14 days and mean weight was 3.01 ± 0.322 kg. Demographic data was similar in both groups as shown in table-I.

Before the start of phototherapy mean serum total bilirubin in all the neonates was 381.16 ± 45.63 µmol/L and after 48 hours of phototherapy it was 268.58 ± 46.91 µmol/L. In control group before and after phototherapy it was 379.42 ± 43.2 µmol/L and 266.30 ± 48.19 µmol/L respectively. And in case group before and after phototherapy it was 382.90 ± 48.30 µmol/L and 270.86 ± 45.96 µmol/L respectively.

Similarly before the start of phototherapy mean serum calcium in all neonates was 2.20 ± 0.14 mmol/L and after 48 hours it was 2.04 ± 0.14mmol/L. In control group before and after phototherapy it was 2.18 ± 0.14 mmol/L and 1.98 ± 0.12 mmol/L respectively. And in case group before and after phototherapy it was 2.23 ± 0.12 mmol/L and 2.09 ± 0.13 mmol/L respectively. There was trend of decrease in serum calcium levels in both groups however decrease in serum calcium levels was more in control group.

Hypocalcemia occurred in 22 (21.2%) neonates out of 104. None of the neonate had symptomatic hypocalcemia. In control group 14 neonates developed hypocalcemia and in case group 8 neonates developed hypocalcemia. Detail is shown in table-II.

Table-II: Frequency of hypocalcemia after phototherapy.

		Control	Case	*p-value
Hypocalcemia	Occurred	14 (26.9%)	8 (15.4%)	0.23
	Not occurred	38 (73.1%)	44 (84.6%)	

*p-value < 0.05 is significant.

Table-III: Stratification of hypocalcemia with or without covering the head with respect to age.

Age Group	Hypocalcemia	Control	Cases	Total	*p-value
<3 days	Yes	3	1	4	0.244
	No	10	13	23	
>3days	Yes	11	7	18	0.31
	No	28	31	59	
Total		52	52	104	

*p-value <0.05 is significant.

Table-IV: Stratification of hypocalcemia with or without covering the head with respect to Gender.

Age Group	Hypocalcemia	Control	Cases	Total	*p-value
Male	Yes	5	5	10	0.82
	No	17	20	37	
Female	Yes	9	3	12	0.081
	No	21	24	45	
Total		52	52	104	

*p-value <0.05 is significant.

Stratification of hypocalcemia with or without covering the head with respect to age and gender is shown in table-III and table-IV respectively.

DISCUSSION

Phototherapy is relatively safe and appropriate method to reduce bilirubin levels in neonatal jaundice. However at times it results in complication like hypocalcemia. And occasionally this hypocalcemia may be associated with jitteriness, irritability and lethargy.

In our study, control group was given phototherapy in conventional way and heads of neonates were not covered. 26.9% neonates developed hypocalcemia and they were not symptomatic. A study published in 2015 had similar results to this in term neonates. It concluded that 30% of term neonates developed hypocalcemia after phototherapy[11]. In few other studies even higher percentage of neonates developed hypocalcemia and were symptomatic. A study was conducted in India in which hypocalcemia was studied in neonates undergoing phototherapy. According to that study 66.67% neonates developed hypocalcemia and among the hypocalcemic neonates 81.25% were symptomatic[12]. Similarly in another study it was observed that 66% of term neonates developed hypocalcemia after phototherapy[13]. However few studies claim that there is no significant reduction in calcium levels after phototherapy in neonates with hyperbilirubinemia[14,15].

Few studies were conducted in which head was covered to reduce the exposure of pineal gland to phototherapy and ultimately reducing hypocalcemia. They described a significant reduction in hypocalcemia in neonates when their heads were covered. A study was conducted in Egypt in which they included 124 neonates. They concluded that 24.2% neonates in without hat group and 9.7% neonates in hat group developed hypocalcemia[16].

In another study conducted in Egypt, it was concluded that 24.4% term neonates with uncoverd heads and 11% term neonates with covered head developed hypocalcemia after 48 hours of phototherapy[17].

Seventy Two full term newborns were included in a similar study from Iran. Results of the study 38.9% neonates with uncovered head and 13.9% neonates with covered head developed hypocalcemia[10]. In our study 26.9% neonates in head uncovered group developed hypocalcemia. This percentage is similar to the studies done in Egypt but less than the study done in Iran. And among the neonates whose heads were covered in our study, 15.4% developed hypocalcemia. This result is close to Iranian study but higher than the Egyptian study. Although our study showed decrease in hypocalcemia by covering the head of neonates but in contrast to all these previous studies which showed significant results, our results were statistically insignificant.

Another study conducted in Iran showed significant reduction in hypocalcemia after covering the heads of icteric preterm infants during phototherapy. In this study control group developed hypocalcemia in 53% of infants while head covered group developed hypocalcemia only in 6% neonates[18]. Another study again from Iran showed significant reduction in hypocalcemia after covering the heads of neaonates during phototherapy. The difference between two groups was significant according to t-test (p=0.036)[19].

There were few limitations that we met during the study. Close contact with the neonates is required to ensure that head was covered all the time during phototherapy except during feeding. And close monitoring is required to observe symptomatic hypocalcemia. But it was not possible all the time due to shortage of staff. Study was conducted in single center with small sample size. Further studies should be conducted in multiple centers and with large sample size to know the significance of head covering more accurately.

CONCLUSION

Phototherapy induced hypocalcemia is established by many studies and few studies showed significant decrease in hypocalcemia

when head of neonate is covered. Although our study showed less hypocalcemia with head covering but results were statistically non-significant. Further large studies should be conducted to know the exact significant of this intervention. If it is proven to be significant then it is an easy and cheap way to prevent hypocalcemia in neonates undergoing phototherapy.

CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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