Original Article

Effect of Covering of Head on Phototherapy Induced Hypocalecmia in Full Term Neonates with Jaundice

Rahida Karim, Jahanzeb Khan Afridi and Mariam Farooq

ABSTRACT

Objective: To see the effect of head covering on frequency of phototherapy induced hypocalcaemia in full term neonates with jaundice.

Study Design: Case control study.

Place and Duration of Study: This study was conducted at the Department of Pediatrics, Hayatabad Medical Complex, Peshawar from 01.07.2016 to 31.12.2016.

Materials and Methods: In this study the total sample size was 128 patients using 13.88% preparation of hypocalcemia among neonates with lead covered during phototherapy 95% confidence interval and 6% margin of error. More over consecutive (Non probability) sampling technique was used for sample collection.

Results: Our study show that in cases group mean age was 11 days with SD ± 3.27. Where as in control group mean age was 10 days with SD ± 2.93. In cases group 62% neonates were male, 38% neonates were female. Where as in control group 65% neonates were male, 35% neonates were female. In cases group 15% neonates had hypocalcaemia. Where as in control group 42% neonates had hypocalcaemia.

Conclusion: Our study concludes that head covering on frequency of phototherapy induced hypocalcaemia is 15% in full term neonates with jaundice.

Key Words: Head Covering, Phototherapy, Hypocalcaemia, Neonates, Jaundice

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INTRODUCTION

Jaundice is one of the common presentations in neonates during first week of life. Worldwide 60% full term neonates are estimated to be affected by jaundice[1]. In Pakistan a study showed that 27.6% new-borns from an area of Karachi were referred to neonatal centre with jaundice.[2] In North America and Europe 0.4 to 2.7 per 100,000 live births develop kernicterus while in developing countries it is reported as 3% of total neonatal hospital admissions.[3]

In some neonates it may result in acute bilirubin encephalopathy which can progress to kernicterus.[1] Early and aggressive treatment of hyperbilirubinemia can prevent this serious complication. Mainstay of treatment is phototherapy and exchange transfusion[1]. These therapies decrease unconjugated bilirubin to non-toxic levels. Improved phototherapy equipment and techniques have reduced the need of exchange transfusions.[4, 5]

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Phototherapy is associated with some complications including skin rash, diarrhoea, hyperthermia, dehydration, DNA damage, degeneration of retina, bronze baby syndrome, patent ductus arteriosus in preterm neonates and hypocalcaemia. Hypocalcaemia in new-borns causes apnoea, convulsion and tetany. It can also cause long-term complications such as mental retardation, physical disability, and educational failure.[6, 7]

To prevent hypocalcaemia during phototherapy intravenous calcium is used in some studies but it may result in cardiac arrest or hypotension. So some means are required to prevent hypocalcaemia during phototherapy.

A latest study was done in Iran in which heads of neonates were covered during phototherapy and it was observed that frequency of hypocalcaemia is less in study group (13.88%) than control group (38.88%).[8] To my knowledge no such study has been done in our province and being working in busy tertiary care hospital like ours it is of great benefit for both neonate and hospital to treat such common condition with such an easy way(by covering the heads of neonates). The results of this study will be shared with local paediatricians to increase awareness and to design future strategies for the treatment of phototherapy induced hypocalcemia.

MATERIALS AND METHODS

This was case control study conducted in department of Pediatrics, Hayatabad Medical Complex, Peshawar from 01.07.2016 to 31.12.2016.

The sample size was 128, using 95% confidence interval, and 90% power of the test and 6% margin of error. Sampling technique was consecutive (Non-probability).

Neonates of both sexes, with gestational age ≥ 37 week, birth weight than 2500 grams with normal calcium level and hyperbillirubinemia were included in the study.

Babies with history of asphyxia, hypothyroidism, hemolytic anemia and sepsis were excluded, all these condition may lead to disturbed serum calcium level.

Data Collection Procedure: Approval was taken from hospital ethical committee. After evaluating neonates for inclusion and exclusion criteria, written informed consent was taken from parents. Full term healthy infants were divided into two groups randomly with the help of computer generated codes and placed in envelops. In one group head was not covered (control group) and in other head was covered with stockinet cap (case group) during phototherapy. Sex, birth weight, serum total bilirubin levels and serum calcium levels, was checked before start of phototherapy. Complete blood picture with reticulocyte count, C-reactive protein, blood culture and sensitivity and thyroid function test was done before phototherapy to rule out haemolytic anaemia, sepsis and hypothyroidism. Routine phototherapy was instituted with 4 lamps, 40 watts, blue light with a wave length of 420-470 nanometres and at a distance of 40 cm from the body surface. Serum Calcium levels and serum total bilirubin was repeated 48 hours after starting phototherapy.

Data Analysis: All data was entered and analysed by using SPSS version 16.0. Frequencies and percentages for qualitative variables like gender and hypocalcaemia. Mean and standard deviation was calculated for quantitative variables like age, birth weight, calcium level and bilirubin levels. Hypocalcaemia was stratified with age, gender, birth weight to see the effect modification. Post stratification chi-square tests were used in which $P \leq 0.05$ was considered as significant. All the results were presented in the form of tables and charts and odds ratio were also be calculated.

RESULTS

A total of 128 patients were observed to determine the effect of head covering on frequency of phototherapy induced hypocalcaemia in full term neonates with jaundice and the results were analyzed as:

Age distribution among two groups was analyzed as in cases group 68(53%) neonates were in age 1-10 days, 38(30%) neonates were in age 11-20 days and 22(17%) neonates were in age 21-28 days. Mean age was 11 days with SD ± 3.27. Where as in control group 64(50%) neonates were in age 1-10 days, 45(35%) neonates were in age 11-20 days and 19(15%) neonates were in age 21-28 days. Mean age was 10 days with SD ± 2.93. (table 1)

Gender distribution among two groups was analyzed as in cases group 79(62%) neonates were male, 49(38%) neonates were female. Where as in control group 83(65%) neonates were male, 45(35%) neonates were female. (table 2)

Body weight among two groups was analyzed as in cases group 87(68%) neonates had weight < 3 kg, 41(32%) neonates had weight ≥ 3kg. Mean weight was 2 kg with SD ± 1.83. Where as in control group 83(65%) neonates had weight < 3 kg, 45(35%) neonates had weight ≥ 3 kg. Mean weight was 2.5kg with SD ± 1.27.

Calcium level among two groups was analyzed as in cases group 67(52%) neonates had calcium level 1.5 - 1.9 mmol/L, 61(48%) neonates had calcium level 1.9 - 2.25 mmol/L. Mean calcium level was 1.9 mmol/L with SD ± 1.51. Where as in control group 64(50%) neonates had calcium level 1.5 - 1.9 mmol/L, 64(50%) neonates had calcium level 1.9 - 2.25 mmol/L. Mean calcium level was 2 mmol/L with SD ± 1.96. (table 3)

Bilirubin level among two groups was analyzed as in cases group 67(52%) neonates had bilirubin level ≤257 µmol/L, 61(48%) neonates had bilirubin level >257 µmol/L. Mean bilirubin level was 260 µmol/L with SD ± 11.83. Where as in control group 64(50%) neonates had bilirubin level ≤257 µmol/L, 64(50%) neonates had bilirubin level >257 µmol/L. Mean bilirubin level was 259 µmol/L with SD ± 10.91. (table 4)

Hypocalcaemia among two groups was analyzed as in cases group 19(15%) neonates had hypocalcaemia, 109(85%) neonates didn't had hypocalcaemia. Where as in control group 54(42%) neonates had hypocalcaemia, 74(58%) neonates didn't had hypocalcaemia. P value was 0.0001 and the odds ratio was 0.2389. (table 5).

P value and odds ratios of hypocalcaemia with respect to age groups were (0.0004; 0.2363) in age group 1-10 years, (0.0089; 0.2566) in age group 11-20 years, (0.0402; 0.2171) in age group 21-28 years. (table 6)

P value and odds ratios of hypocalcaemia with respect to gender were (0.0002; 0.2456) in male, (0.0025; 0.2281) in female.

P value and odds ratios of hypocalcaemia with respect to weight were (0.0001; 0.2409) with weight <2kg, (0.0049; 0.2346) weight >2kg.

Table No.1: Age Distribution (n=256)

Age	Case	Control
1-10 days	68(53%)	64(50%)
11-20 days	38(30%)	45(35%)
21-28 days	22(17%)	19(15%)
Total	128(100%)	128(100%)
Mean and SD	11 days ± 3.27	10 days ± 2.93

T test was applied in which P value was 0.0105

Table No.2: Gender Distribution (n=256)

Gender	Case	Control
Male	79(62%)	83(65%)
Female	49(38%)	45(35%)
Total	128(100%)	128(100%)

Chi square test was applied in which P value was 0.6040

Table No.3: Calcium Level (n=256)

Calcium level	Case	Control
1.5 - 1.9 mmol/L	67(52%)	64(50%)
1.9 - 2.25 mmol/L	61(48%)	64(50%)
Total	128(100%)	128(100%)
Mean and SD	1.9 mmol/L ± 1.51	2 mmol/L ± 1.96

T test was applied in which P value was 0.6479

Table No.4: Bilirubin Levels (n=256)

Bilirubin level	Case	Control
≤ 257µmol/L	67(52%)	64(50%)
> 257µmol/L	61(48%)	64(50%)
Total	128(100%)	128(100%)
Mean and SD	260 µmol/L ± 11.83	259 µmol/L ± 10.91

T test was applied in which P value was 0.4827

Table No.5: Association of Hypocalcemia with Covered and un Covered Head (n=256)

Hypocalcemia	Case	Control
Yes	19(15%)	54(42%)
No	109(85%)	74(58%)
Total	128(100%)	128(100%)

Chi square test was applied in which P value was 0.0001 Odds ratio: 0.2389

Table No.6: Stratification of hypocalcemia w.r.t age distribution (n=256)

Age	Hypocal-cemia	Case	Control	P value	Odd ratios
1-10 days	Yes	10	27	0.0004	0.2363
	No	58	37		
Total		68	64		
11-20 days	Yes	6	19	0.0089	0.2566
	No	32	26		
Total		38	45		
21-28 days	Yes	3	8	0.0402	0.2171
	No	19	11		
Total		22	19		

DISCUSSION

Jaundice is one of the common presentations in neonates during first week of life. Worldwide 60% full term neonates are estimated to be affected by jaundice[1]. In Pakistan a study showed that 27.6% new-borns from an area of Karachi were referred to neonatal centre with jaundice.[2] In North America and Europe 0.4 to 2.7 per 100,000 live births develop kernicterus while in developing countries it is reported as 3% of total neonatal hospital admissions.[3]

Our study show that in cases group mean age was 11 days with SD ± 3.27. Where as in control group mean age was 10 days with SD ± 2.93. In cases group 62% neonates were male, 38% neonates were female. Where as in control group 65% neonates were male, 35% neonates were female. In cases group mean weight was 2 kg with SD ± 1.83. Where as in control group mean weight was 2.5kg with SD ± 1.27. In cases group mean calcium level was 1.9 mmol/L with SD ± 1.51. Where as in control group mean calcium level was 2 mmol/L with SD ± 1.96. In cases group mean bilirubin level was 260 µmol/L with SD ± 11.83. Where as in control group mean bilirubin level was 259 µmol/L with SD ± 10.91. In cases group 15% neonates had hypocalcaemia, 85% neonates didn't had hypocalcaemia. Where as in control group 42% neonates had hypocalcaemia, 58% neonates didn't had hypocalcaemia.

A latest study was done in Iran in which heads of neonates were covered during phototherapy and it was observed that The mean±SD weight and age of the neonates were 3080±389.3 grams and 4.52±1.3 days, respectively. 32 (44.4%) neonates were boys and 40 (55.6%) were girls. The average time of phototherapy was three days (range: 3-5 days). The mean±SD serum bilirubin level was 14.3±1.2 mg/dl. Hypocalcaemia was found in 14 (38.88%) out of 36 newborns in the control group [8]

As far as adverse events of exchange Transfusion in both groups were concerned, based on our observations we found out that more neonates suffered from Hypocalcemia in comorbid group as compared to control group (29.03% vs 9.67%) which were statistically significant (p<0.00637). This conforms to many studies in literature which have consistently found higher proportions of neonates suffering from hypocalcemia. This is readily explained by different pathophysiological mechanisms which lead to deranged metabolic functions in neonates suffering from comorbid conditions like Sepsis, severe anemia, Pneumonia, and as a consequence blood calcium level drops more readily in such babies. However sex stratification in both comorbid and control group lead to the observation that male neonates suffering from hypocalcemia were relatively higher than female neonates (34.21% vs 20.83%) and (10% vs 9.37%). This is in contrast to what we found from some other studies in the literature where it has been reported that more female neonates suffered from Hypocalcemia as compared to male neonates.[9, 10]

Romagnoli and colleagues were the first to suggest an association between hypocalcaemia and phototherapy in neonates.[12] Other researchers also observed a significant decrease in serum calcium levels in newborn rats after exposure to fluorescent day light.[11] In another study on 20 term and 20 preterm neonates with hyperblirubinemia, 75% of term and 90% of preterm

neonates developed hypocalcaemia after phototherapy.[13] The results of the above mentioned studies are consistent with ours. In one study hypocalcaemia was observed in 30% of the term neonates receiving phototherapy[14] which is lower than the above mentioned studies. We found that three infants in the control group with calcium level below 7 mg/dl and were controlled by a physician.

The role of calcium in the body includes blood coagulation, neuromuscular excitability, cell membrane integrity and function, and cellular enzymatic and secretory activity. Cellular permeability to sodium ions and increased cell membrane excitability are the signs of hypocalcaemia and other non-specific signs are apnea, seizure, jitteriness, increased extensor tone, clonus, hyper-reflexia, and stridor.[15]

Studies on 63 full-term newborns weighting more than 2500 grams, confirmed the emergence of hypocalcaemia after phototherapy, and researchers recommended prophylactic calcium for one of the infants who developed apnea.[16] In one study, 27.3% of the premature infants who were irritable had hypocalcaemia during phototherapy. Moreover, vitamin D had no role in the pathogenesis of phototherapy induced-hypocalcaemia[17] and administration of calcium was thus recommended during phototherapy.[12, 15]

Hypocalcaemia in infants may be symptomatic or asymptomatic.[18] Some studies have reported asymptomatic hypocalcaemia in neonates.[12] None of the newborns in our study had symptomatic hypocalcaemia and had phototherapy-induced hypocalcaemia.

In addition, sometimes hypomagnesaemia and hypocalcemia can occur concomitantly. One study reported that 16 out of 29 neonates developed concomitant hypomagnesaemia and hypocalcaemia.[9] In case of decreased calcium levels, infants might also need magnesium. But in our study, no significant difference in magnesium levels was found between the two groups 48 hr after starting phototherapy (P=0.24), which indicated that none of the infants had magnesium amount below 1.2 mg/dl. It was not necessary to give magnesium to the infants with hypocalcaemia.

It is suggested that covering the pineal gland only helps prevent hypocalcaemia. The level of calcium in the control group reached the normal range after phototherapy. In fact, light affected melatonin concentration followed by a decrease in serum calcium level. This study showed that neonates requiring phototherapy were at a higher risk of developing hypocalcaemia.

CONCLUSION

Our study concludes that head covering on frequency of phototherapy induced hypocalcaemia is 15% in full term neonates with jaundice.

Author's Contribution:

Concept & Design of Study:	Rahida Karim, Jahanzeb Khan Afridi
Drafting:	Rahida Karim, Marium Farooq
Data Analysis:	Rahida Karim, Marium Farooq
Revisiting Critically:	Marium Farooq, Jahanzeb Khan Afridi
Final Approval of version:	Rahida Karim, Jahanzeb Khan Afridi

Conflict of Interest: The study has no conflict of interest to declare by any author.

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