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The Effect of Phototherapy on Serum Calcium in Neonates with Indirect Hyperbilirubinemia

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Abstract: Background: Neonatal jaundice is considrable problem in neonatal nursery .It occures in around 60 % of full term and 80 % of preterm. It might be physiological or pathological, indirect or direct hyperbilirubinemia. If unconjugated hyperbilirubinemia is untreated, it is possibly results in hazardous effect [kernicterus]. Phototherapy is an important method for treatment of hyperbilirubinemia, which is proved to be a good and effective option of management in cases of unconjugated hyperbilirubinemia. However, it is not a definitely safe intervention, it might cause many undesired effects. Hypocalcemia is a major metabolic issue in babies. It is characterized as total serum calcium concentration less than or equivalent to 7.5 mg/dl. It happens in normally newborn children, prematures, babies of diabetic moms, after "perinatal asphyxia" or "intrauterine development restriction and low calcium intake.

Aim of study: to evaluate the effect of phototherapy on serum calcium in neonates with indirect hyperbilirubinemia.

Methods: A cross sectional study was achieved. Assessment of neonates clinically with details history and physical examination was carried out. Gestational age was assessed, duration of phototherapy was recorded. Serum bilirubin and calcium were checked up on admission, and after 24 hours from starting phototherapy.

Result: In this study, forty neonates with jaundice were enrolled with mean gestational age of (37.1 weeks); 30% of them had preterm gestational age and 70% of them had term gestational age. Male jaundiced neonates were more than females (55% vs. 45%). Breast-feeding was present for 5% of jaundiced neonates, while 50% of them were on formula feeding and 45% of neonates were on mixed feeding. Mean serum calcium before phototherapy of jaundiced neonates was (8.9 mg/dl), while mean serum calcium 24 hours after phototherapy of jaundiced neonates was (8.6 mg/dl). The mean serum calcium of jaundiced neonates was not significantly different before and 24 hrs after phototherapy (p=0.17) .The mean serum calcium of jaundiced neonates was not significantly different before and 24 hrs after ordinary phototherapy (p=0.7). The mean serum calcium of jaundiced neonates was not significantly different before and 24 hrs after extensive phototherapy (p=0.17).

Conclusion: There is no association between phototherapy and neonatal hypocalcemia.

Key words: hyperbilirubinemia, hypocalcemia, phototherapy, prematurity.

INTRODUCTION:

Neonatal jaundice is serious issue and is shows up during first seven days stretch of life in around 60 % of full term and 80 % of preterm youngsters. It refers to the yellowish discoloration of the "skin and sclera" that occurs with the accumilation of bilirubin in the skin and seclera tissues. Ordinarily in

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the body, bilirubin is handled through the liver, where it is formed to glucuronic corrosive by the chemical uridine diphosphate glucuronyl transferase (UGT) 1A1. It might be physiological or pathological and indirect or direct hyperbilirubinemia [1]. In many babies with physiologic jaundice, bilirubin fixations don't ascend to a point that requires treatment. In any case, in certain babies with overstated physiological jaundice, and in numerous newborn children with pathological jaundice, bilirubin in the blood arrives at extremely high focuses that put the baby in danger for intense and constant bilirubin encephalopathy [kernicterus]. If unconjugated hyperbilirubinemia is untreated ,it is possibly hazardous effect [2]. The conjugated bilirubin types is then discharged into the bile and eliminated from the body through the gut. At the point when this discharge cycle is low (following birth), the cycle doesn't work effectively, or is over by so much endogenously delivered bilirubin, bilirubin in the body increase , bringing about “hyperbilirubinemia and jaundice” [3]

Common risk factor for unconjugated hyperbilirubinemia include: fetomaternal, mother –baby incompatibility, premature delivery, previous history of sibling with sever hyperbilirubinemia, cephalhemotomas, bruising and trauma from assisted delivery. Successful managment to diminish bilirubin levels in newborn children with extreme jaundice incorporate ‘phototherapy” and “exchange transfusion” .It is generally essential, phototherapy focuses for the utilization of light to change over bilirubin particles in the body into water dissolvable isomers that can be discharged out side of the body.[4]

The impact of light on jaundiced children, and the capacity of the light to diminish levels of serum bilirubin, was first depicted by Cremer et al in nineteen fifty eight . This perception prompted the improvement of light hotspots for use in the treatment of babies with hyperbilirubinemia. Phototherapy is an important method for treatment of hyperbilirubinemia which is proved to be a good and effective option of management in cases of unconjugated hyperbilirubinemia[5] .However, it is not a definitely safe intervention, it might cause many after effects like parchedness, temperature shakiness, skin rashes, loose stools, retinal harm, bronze baby syndrome geno toxicity [4,5,6,]. It produces its effect by photo isomerization of bilirubin and changes its solubility to be more soluble in water and less lipophilic kind of bilirubin, which is securely lost in bile, dung and pee [5].Neonatal hypocalcaemia a typical issue in youngster nursery unit. It is characterized as total serum calcium concentration less than or equivalent to 7.5 mg/dl· [6] Hypocalcemia is a major metabolic issue in babies. During gestation, calcium is moved through the mother dissemination to the embryo by a pump directed by parathyroid related biocamicals. Highest intrauterine calcium level is happening in the last three months of pregnancy. This cycle brings about higher blood calcium levels in the baby than in the mother and prompts fetal hypercalcemia, with absolute calcium grouping of “2.50 to 2.75” mmol/L in the umbilical rope blood [3] .

The finish of placental trade of calcium close to birth time is followed by a decrease in complete blood calcium to 2.00 to 2.25 mmol/L and ionized calcium to as low as 1.1 to 1.35 mmol/L at 24 hours. Calcium levels thusly rise, showing up at levels found in additional carefully prepared kids and adults by two weeks[3]

Early neonatal hypocalcemia is a distortion of the ordinary decrease in calcium fixation after birth. It happens in : normally untimely newborn children, in babies of diabetic moms, after “perinatal asphyxia” or “intrauterine development restriction.[5]1\3 of premature babies and most of extremely low-birth-weight babies foster hypocalcemia during the underlying two days after birth. Various elements add to the fall of calcium : incorporate hypoalbuminemia, decreased admission of calcium to the body , in light or low admission of milk, conceivable hindered reaction to parathyroid chemical, expanded calcitonin levels, and expanded urinary calcium losses [1].

Hypocalcemia happens in 10% to 20% of newborn children of diabetic moms. The most reduced fixation regularly happens between twenty four to seventy two hours after delivery and frequently is related with hyperphosphatemia[6]. Hypocalcemia is brought about by lower parathyroid chemical fixations after birth in this condition contrasted with healthy babies. Hypoparathyroidism is possibly connected with intrauterine hypercalcemia . Simultaneous hypomagnesemia is another contributing

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element[2].Newborn children with birth asphyxia as often as possible have hypocalcemia and hyperphosphatemia. Potential systems incorporate expanded phosphate load brought about by: tissue catabolism, diminished admission because of deferred inception of feedings, renal malfunction , acidosis, and expanded serum calcitonin fixation[4]. Hypocalcemia happens with expanded recurrence in newborn children with intrauterine development limitation. The mechanism of it is include diminished move of calcium across the placenta.[2]

Aim of study:

This study aimed to evaluate, the effect of phototherapy on serum calcium in neonates with indirect hyperbilirubinemia after 24 hours of exposure to phototherapy.

Methods

The cross sectional study was conducted, from May 2021 to October 2021, on 40 neonates admitted in neonatal intensive care unit of Al Falluja teaching hospital for maternity and children, and after getting proper ethical approval of scientific committees of the college and hospital and of course parental consent. Assessment of neonates clinically with details history and physical examination was carried out in these cases . Gestational age was assessed, duration of phototherapy was recorded, Serum bilirubin and calcium were checked up on admission, and after 24 hours from starting phototherapy. The calcium levels of the infants' blood samples were re measured. The neonate's informations were entered and interpreted statistically by SPSS program-26. Suitable tables were implemented accordingly. The paired t-test was used for continuous variables. P value of ≤0.05 was regarded as significant.

Results

In this study, forty neonates with jaundice were enrolled with mean gestational age of (37.1 weeks); 30% of them had preterm gestational age and 70% of them had term gestational age. Male jaundiced neonates were more than females (55% vs. 45%). Mean birth weight of neonates was (2.7 Kg); 37.5% of them had low birth weight. The prevalent blood group of jaundiced neonates was blood group B+ve (30%); followed by blood group O+ve (25%), blood group A+ve (22.5%), etc. (***Table 1***)

Table 1: General characteristics of neonates.

Variable	No.	%
Gestational age mean±SD (37.1±2.5 weeks)		
Preterm	12	30.0
Term	28	70.0
Gender		
Male	22	55.0
Female	18	45.0
Birth weight mean±SD (2.7±0.7 Kg)		
Low	15	37.5
Normal	25	62.5
Blood groups		
A+ve	9	22.5
B+ve	12	30.0
AB+ve	6	15.0
O+ve	10	25.0
A-ve	1	2.5
B-ve	1	2.5
O-ve	1	2.5
Total	**40**	**100.0**

Intercurrent RDS was observed in 12.5% of jaundiced neonates, while no pneumonia and sepsis were reported. Breast feeding was present for 5% of jaundiced neonates, while 50% of them were on formula feeding and 45% of neonates were on mixed feeding. The family history of hypocalcaemia was not reported. (***Table 2***)

Table 2: Clinical characteristics of neonates.

Variable	No.	%
Intercurrent RDS		
Positive	5	12.5
Negative	35	87.5
Pneumonia		
Negative	40	100.0
Sepsis		
Negative	40	100.0
Type of feeding		
Breast feeding	2	5.0
Formula feeding	20	50.0
Mixed feeding	18	45.0
Family history of neonatal hypocalcaemia		
Negative	40	100.0
Total	**40**	**100.0**

Mean total serum bilirubin of jaundiced neonates was (14.4 mg/dl); 10% of them had TSB of 10 mg/dl and less, 85% of them had TSB of 11-20 mg/dl and 5% of them had TSB of more than 20 mg/dl. Mean serum calcium before phototherapy of jaundiced neonates was (8.9 mg/dl), while mean serum calcium 24 hours after phototherapy of jaundiced neonates was (8.6 mg/dl). Phototherapy used was ordinary in 47.5% of jaundiced neonates and extensive phototherapy for 52.5% of them. The calcium was used before phototherapy in 10% of jaundiced neonates. Mean duration of admission for jaundiced neonates was (3.9 days); 17.5% of jaundiced neonates had admission duration of more than five days. (***Table 3***)

Table 3: Investigations and hospital stay of neonates.

Variable	No.	%
Total serum bilirubin level mean±SD (14.4±4 mg/dl)		
≤10 mg/dl	4	10.0
11-20 mg/dl	34	85.0
>20 mg/dl	2	5.0
Serum calcium before phototherapy mean±SD (8.9±1 mg/dl)		
Serum calcium 24 hrs after phototherapy mean±SD (8.6±0.9 mg/dl)		
Type of phototherapy		
Ordinary	19	47.5
Extensive	21	52.5
Use of calcium before phototherapy		
Yes	4	10.0
No	36	90.0
Duration of admission mean±SD (3.9±3.7 days)		
One day	7	17.5
Two-five days	26	65.0
More than five days	7	17.5
Total	**40**	**100.0**

The mean serum calcium of jaundiced neonates was not significantly different before and 24 hrs after phototherapy (p=0.17). The mean serum calcium of jaundiced neonates was not significantly different before and 24 hrs after ordinary phototherapy (p=0.7). The mean serum calcium of jaundiced neonates was not significantly different before and 24 hrs after extensive phototherapy (p=0.17). (***Table 4***)

Table 4: Distribution of serum calcium according to study duration and phototherapy types.

Variable	Study duration		P
	Before phototherapy	24hrs after phototherapy	
	Mean±SD	Mean±SD	
All neonates			0.17 NS
Serum calcium (mg/dl)	8.9±1	8.6±0.9	
Ordinary phototherapy			0.7 NS
Serum calcium (mg/dl)	8.8±0.9	8.7±0.8	
Extensive phototherapy			0.17 NS
Serum calcium (mg/dl)	8.9±1.1	8.5±1	

NS=Not significant.

Discussion:

The relationship between phototherapy and calcium deficiency is not agreed upon and it is contradictory. Some studies support the existence of this relationship and some deny its existence at all. Several research papers related to this topic were reviewed in order to fully understand it in order to reach the results of a convincing study that supports or denies the presence of this relationship. The results of our study showed that there is no real relationship between phototherapy and the fall in calcium levels of neonate patients who are hospitalized at neonate ward .There may be a relationship with looking at the results at a glance, but it is statistically negligible. This result agrees with the study carried out by Carissa Lidia etal. and Fatemeh Haji Ebrahim Tehrani etal. [7,8]. Our result supports a summary of the results reached by the scientific editors of the scientific references of pediatrics, who had not documented this relationship until now [6]. The results of our research contradict the results reached by Mashal Khan and his colleagues in proving this relationship[9]. The reason for this discrepancy among the results of the the studies may be the size of the sample in our study compared to their samples, in addition to that they may take samples from multiple health centers and hospitals, while we took samples of our patients from one hospital. How over, to be realistic, a significant number of researches that linked the relationship between phototherapy and hypocalcemia in neonates stated that there are no important clinical signs indicating the importance of hypocalcemia, and therefore there is no need for therapeutic interventions. [10]

Conclusion:

There is no association between phototherapy and neonatal hypocalcemia.

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