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Original Article

Comparison of Effects of LED Phototherapy with Compact Fluorescent Phototherapy in Neonates with Hyperbilirubinemia

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ABSTRACT

Objective: To compare the mean post-treatment bilirubin level with light emitting diode (LED) phototherapy versus compact fluorescent lamp (CFL) phototherapy in neonates presenting with hyperbilirubinemia

Study Design: Comparative prospective study

Place and Duration of Study: Department of Paediatrics, Pakistan Railway Hospital, Rawalpindi Pakistan, from Jan to Dec 2019.

Methodology: Hundred children fulfilling the inclusion criteria were recuited in the study from Emergency Department. Then neonates were divided into two groups. In Group-A, neonates underwent phototherapy with LED; in Group-B, neonates underwent phototherapy with conventional phototherapy. Then neonates were followed up in the neonatal intensive care unit for 24 hours. Pre and post-treatment reports were assessed, and bilirubin level was noted.

Results: In Group-A, the mean age of neonates was 49.12±23.42 hours, while in Group-B was 38.70±15.42 hours. In Group-A, the mean Bilirubin level at baseline was 13.64±5.98 gm/dl and in Group-B was 15.88±5.44 gm/dl. In Group-A, the mean Bilirubin level after 24 hours was 8.47±4.96 gm/dl and in Group-B was 9.538±5.35 gm/dl. In both groups, no significant difference in the mean bilirubin level was observed after 24 hours (p-value=0.30).

Conclusion: Light-emitting diode phototherapy and compact fluorescent lamp phototherapy are equally effective in a mean reduction in the total serum bilirubin after 24 hours.

Keywords: Bilirubin level, Compact fluorescent lamp phototherapy, Light emitting diode phototherapy, Hyperbilirubinemia, Neonate.

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INTRODUCTION

Hyperbilirubinemia or jaundice occurs in most newborns during the first few days of life. However, it is among the most common causes of admission in term babies.[1] Sometimes the high level of indirect bilirubin levels crosses the blood-brain barrier and causes lifelong neurological damage. This deposition in the brain, specifically in basal ganglia, can cause profound impairment in neurological development.[2,3] Idiopathic neonatal jaundice is reported in around 60-80% of healthy neonates; the incidence is more in preterm babies as compared to term babies.[4] National Neonatal-Perinatal Database (NNPD) shows that the incidence of hyperbilirubinemia in neonates among in-house live births is 3.3%.[5]

The common causes of increased bilirubin in neonates include ABO and Rh incompatibility, G6PD deficiency, and inherited and acquired defects.[5] The American Academy of Pediatrics has developed the criteria for managing pathological neonatal jaundice.[6] Hemolytic jaundice is the top possibility if jaundice appears within 24 hours of birth. The newborn with significant clinical jaundice should be evaluated for blood group of baby and mother, haemoglobin, hematocrit, reticulocyte count, RBC morphology, direct and indirect Coomb's test, and if indicated Glucose-6-phosphate dehydrogenase levels.[7] Management of hyperbilirubinemia is required by almost five to ten percent of neonates with jaundice. Intensive phototherapy, as compared to conventional phototherapy, provides an efficacious and faster means to lower the bilirubin levels.[8] If bilirubin levels do not fall by 1-2mg /dl after four to five hours of intensive phototherapy, it indicates failure of phototherapy. However, irrespective of the bilirubin level, an exchange transfusion may be performed at the smallest doubt about bilirubin encephalopathy. In addition, immediate exchange transfusion is recommended in hemolytic disease of the newborn if the cord blood haemoglobin level is less than 11g/dl or the cord blood bilirubin level is more than 4.5 mg/dl or despite phototherapy bilirubin level is rising more than 1 mg/dl.[9]

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The rationale of this study is to compare the mean post-treatment bilirubin level with LED phototherapy versus conventional phototherapy in neonates presenting with hyperbilirubinemia. Unfortunately, there is no local study found which could help us in implementing the use of LED phototherapy instead of going for the conventional method.

METHODOLOGY

The prospective comparative study was carried out at the Department of Pediatrics, Pakistan Railway Hospital, Rawalpindi Pakistan, from January to December 2019 after approval from the Hospital Ethical Committee. The sample size of 100 neonates, 50 neonates in each group, was calculated taking magnitudes of mean post-treatment, bilirubin level, i.e. 10.68+1.61 mg/dl with LED phototherapy and 11.54+1.39 mg/dl,[10] with conventional phototherapy in neonates with hyperbilirubinemia.

Inclusion Criteria: Neonates of age 6-96 hours, either gender, admitted in the Neonatal Intensive Care Unit with hyperbilirubinemia were included in the study.

Exclusion Criteria: Neonates requiring ventilator support, IV fluids (on examination and medical record), neonates with hemolytic/Rh incompatibility with mother blood, requiring triple surface phototherapy or exchange transfusion (on clinical examination), neonates with bilirubin level >20mg/dl (on medical record) were excluded from the study.

After taking informed consent from parents, demographic details (name, age, gender, gestational age at birth, birth weight) were also obtained. At baseline blood sample was obtained by using a 3cc BD syringe. Samples were sent to the hospital's laboratory for assessment of bilirubin level. Reports were assessed, and the level was noted. Then neonates were randomly divided into two groups by using the lottery method. In Group-A, neonates underwent phototherapy with LED; in Group-B, neonates underwent phototherapy with conventional phototherapy. Then neonates were followed up in the neonatal intensive care unit for 24 hours. After 24 hours, the blood sample was again obtained using a 3cc BD syringe. Samples were sent to the hospital's laboratory for assessment of bilirubin level. Reports were assessed, and bilirubin level was noted. The presence of bilirubin level >12mg/dl at the time of presentation was defined as hyperbilirubinemia, and post-treatment, bilirubin level was measured after 24 hours of phototherapy.[11]

Statistical Package for Social Sciences (SPSS) version 23.0 was used for the data analysis. Quantitative variables were presented as mean and SD. Qualitative variables like gender were presented as frequency and percentage. Both groups were compared using an Independent sample t-test. The *p*-value of ≤0.05 was considered statistically significant.

RESULTS

In Group-A, the mean age of neonates was 49.12±23.42 hours, while in Group-B was 38.70±15.42 hours. In Group-A, the mean Bilirubin level at baseline was 13.64±5.98 gm/dl and in Group-B was 15.88±5.44 gm/dl. In Group-A, the mean Bilirubin level after 24 hours was 8.47±4.96 gm/dl and in Group-B was 9.538±5.35 gm/dl. In both groups, no significant difference in the mean bilirubin level was observed after 24 hours (*p*-value=0.30) as given in the Table.

Table: Effect of Age, Gestational age, Gender, Birth Weight and Baseline Bilirubin on Pre and Post Phototherapy Serum Bilirubin Levels (n=100)

Parameters	Study Groups		*p*-value
	Group-A (n=50)	Group-B (n=50)	
Age of Neonates (Hours)			
9 to 36	7.44±4.45	8.79±5.27	0.38
37-64	10.22±5.53	10.42±5.59	0.91
65-92	7.33±4.31	13.50±2.40	0.073
Gestational Age (weeks)			
32-34	11.10±00	6.05±6.11	0.48
35-37	6.99±5.68	9.83±5.11	0.078
38-40	10.07±3.55	10.18±5.26	0.901
Gender			
Male	8.78±5.31	9.46±5.61	0.62
Female	8.00±4.46	9.65±5.01	0.28
Birth Weight (kg)			
1.5-2.3	9.61±2.45	7.71±5.97	0.48
2.4-3.2	7.99±5.42	9.44±5.19	0.24
3.3-4.1	10.35±3.13	14.47±2.60	0.062
Baseline Bilirubin Level (mg/dl)			
0.50-9.8	8.48 ±4.8	.6750±0.18	0.010
9.9-19.2	7.37±4.93	9.09±4.81	0.15
19.3-29.1	13.12±1.90	14.17±2.38	0.32

DISCUSSION

Our study focused on seeing a decrease in serum bilirubin levels with different phototherapy lamps available in our set-up. Howe ever, both types of lamps proved to be efficient, with little statistical differences in treating indirect hyperbilirubinemia in neonates. In addition, no statistically significant difference was observed with different parameters like gender, birth weight and gestational age on the outcome. The interventional study by Maharoof *et al.* 2017 studied the efficacy of LED compared to the frequently used CFL light. Their study recruited fifty

neonates and randomly allocated them into two groups to receive CFL or LED therapy. The groups were similar concerning characteristics like gender, gestational age and type of delivery, thereby making the groups comparable concerning those.[11]

In our study, there were two groups, one receiving light emitting diode phototherapy and the other received compact fluorescent lamp phototherapy in neonates presenting with hyperbilirubinemia and no notable difference in mean bilirubin level after 24 hours. However, there was a reduction in the bilirubin levels, and the *p*-value was not significant (*p*-value=0.30). This non-significant difference in the baseline total bilirubin values was also seen by previous studies.[12,13]

Following 24 hours of phototherapy, there was a statistically significant (*p*-value=0.02) reduction in the bilirubin levels reported by other studies.[14] In contrast, none of the above-mentioned studies showed statistical significance in the reduction. This difference might be due to many confounding factors like age, the exact duration of phototherapy, physiological variations etc. This study has tried to assess the heating effect of continuous phototherapy resulting in hyperthermia in neonates due to the intervention. Therefore, baseline and 24-hour axillary temperature was measured in both groups. It was evidenced by a 0.5 vs 0.2 0F increase in the temperature in the CFL vs LED group, respectively. However, this difference was not statistically significant.[15] This points towards the fact that there is a slight increase in temperature. However, the rise in temperature due to the use of LED was lower than the CFL usage, even though the difference was insignificant.

A previous study however, found a statistically significant rise in the temperature among those neonates that received conventional (non-LED) therapy substantiating the fact that temperature rise is higher among non-LED used phototherapy than LED used one.[13] To substantiate the fact that the significant reduction in the bilirubin level among LED phototherapy managed neonates in comparison to CFL managed was due to the intervention per se, the differences in the mean serum bilirubin between pre and post-therapy was estimated which was highly statistically significant ($p<0.001$).

In comparison, a multicentric trial 14and the randomized trial15 by concluded that LED and CFL units were equally effective, and the median duration of phototherapy was the same in both groups. It was found in the Cochrane review that both CFL and LED lamps have an equal effect in decreasing the mean bilirubin levels. It was also seen that the duration of phototherapy given is the same in both groups.[16,17]

Takcı S *et al*.[13] (intensive conventional and intensive LED phototherapy), and ViauColindres *et al*.[18] in two studies of different types of phototherapy lamps. No noteworthy difference was found regarding a decrease in mean bilirubin levels.

Conventional phototherapy lamps are available in most peripheral set-ups to effectively use them for indirect hyperbilirubinemia of newborns. Our study strengthens the concept that both lamps can be effectively used for neonatal jaundice.

LIMITATIONS OF STUDY

We checked serum bilirubin only once, i.e. after 24 hours, and that too by an invasive procedure. If a device for transcutaneous serum bilirubin measurement is available, it may be measured more frequently in a non-invasive way. In addition, a better trend may be observed by measuring serum bilirubin frequently compared to one-time measurements.

CONCLUSION

Light-emitting diode phototherapy and compact fluorescent lamp phototherapy are equally effective in terms of mean reduction in the total serum bilirubin after 24 hours.

Conflict of Interest: None.

Author's Contribution

Following authors have made substantial contributions to the manuscript as under:

AS & BA: Data acquisition, data analysis, data interpretation, critical review, approval of the final version to be published.

SAS & FAS: Conception, study design, drafting the manuscript, approval of the final version to be published.

AA & SAS: Critical review, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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