ORIGINAL ARTICLE

Comparison of light-emitting diodelights vs fluorescent light phototherpy for the treatment of unconjugated hyperbilirubinemia in preterm infants — Randomised Control Trial

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Abstract

Objective: To compare the mean treatment duration of phototherapy when done with light-emitting diodelights versus fluorescent lights for the treatment of unconjugated hyperbilirubinaemia in preterm infants.

Methods: The randomised controlled trial was conducted at Allied Hospital, Faisalabad, Pakistan, from September 12, 2015, to March 11, 2016, and comprised patients with unconjugated hyperbilirubinaemia. Detailed history, including demographic information, were noted. The patients were divided into two groups using computer-generated random number tables. Group A received light-emitting diode light phototherapy and group B received fluorescent light phototherapy. Initially complete blood count with peripheral film, retic count, coombs test, blood group, serum bilirubin level (total, direct, indirect) were done. Serum bilirubin was checked by bilirubinometre 6hourly till the end of treatment. Data analysis was done using SPSS 20.

Results: There were 460 patients divided into two equal groups of 230(50%) each. Mean age was 32.34±2.28 weeks in Group A and 32.21±2.11weeks in Group B. In Group A, 116(50.43%) subjects were boys and 114(49.57%) were girls. In Group B, 120(52.17%) were boys and 110(47.83%) were girls. Mean duration of treatment was recorded as 36.83+2.09 hours in Group A and 45.66+2.52 hours in Group B. (p=0.0001).

Conclusions: The mean duration of treatment of phototherapy with light-emitting diodelights lights was significantly shorter compared to fluorescent lights.

Keywords: Preterm infants, Unconjugated hyper bilirubinemia, Phototherapy, LED lights, Fluorescent lights, Mean duration. (JPMA 69: 767; 2019)

Introduction

Hyper bilirubinaemia is the elevated total serum bilirubin level that results in the yellowish discolouration of the skin or sclera. It can be conjugated or unconjugated. Hyper bilirubinaemia develops in 60% of term and 80% of preterm neonates during the first seven days of life.[1] Due to immature red blood cells, hepatic cells and intestinal system and delay in initiating enteral feed, hyperbilirubinaemia is more frequent and more severe in preterm infants.[2] As the blood-brain barrier of newborn is poorly formed, the major impact of hyperbilirubinaemia is bilirubin-induced encephalopathy, which occurs when unconjugated bilirubin binds to brain tissue after crossing the blood-brain barrier.[3] Neurological sequelae of bilirubin on brain could be acute bilirubin encephalopathy (ABE), and if chronic it is called kernicterus which is permanent disability.[4] In preterm neonates, kernicterus occurs at lower bilirubin levels.[5] Two main treatment options to avoid bilirubin-induced brain destruction in newborns are phototherapy and exchange blood transfusion.[6] The mode of treatment is decided according to the severity of hyper bilirubinaemia.[1]

Phototherapy is a comparatively safer method than the risk factors associated with exchange transfusion.[7] Phototherapy uses the blue lights to photo isomerise bilirubin into non-toxic by-product that can be excreted into bile or urine.[8] There are only a few hazards of phototherapy, including bronze baby syndrome, diarrhoea and mild dehydration.[9] Phototherapy can be done by using fluorescent tubes, halogen bulbs and fibre-optic blankets and newly-developed light emitting diodes (LEDs), which have very high radiant energy in contrast to other recent sources.[10]

Fluorescent tubes and halogen bulbs have some significant drawbacks as they produce considerable heat and have a lifespan of 1000 to 1500 hours, while fibre-optic blankets have limited exposure area.[11,8]

LEDs, on the other hand, have been studied recently as an alternative source in phototherapy units. LEDs produce less heat, have life span of an average of 20,000h and they consume less energy compared to conventional light sources, making LEDs economical. Monochromatic, high-

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intensity light of 458nm wave length is provided by LEDs which intersect the absorption spectrum of bilirubin.[13]

Recent studies from all over the world showed that LED phototherapy is as much beneficial as conventional phototherapy.[12,10] In one study, treatment duration was 37.5 ± 26.8 in patients undergoing LED phototherapy while it was 45.3±32.1 in patients undergoing fluorescent tube phototherapy.[11] To our knowledge, there is no study done in Pakistan on this topic. The current study was planned to compare treatment duration of LED with fluorescent lights for unconjugated hyper bilirubinaemia in preterm neonates.

Patients and Methods

The randomised controlled trial (RCT) was conducted at the Neonatology Unit of Allied Hospital, Faisalabad, Pakistan, from September 12, 2015, to March 11, 2016, and comprised preterm neonates of either gender having unconjugated hyper bilirubinaemia and admitted through either outpatient department (OPD) or emergency. Sample size was calculated by keeping level of significance 5%, and power of study 80%.

After obtaining permission from the institutional ethics review committee, patients were enrolled using consecutive non-probability sampling, No blinding was done. Informed written consent was obtained from the parents. Unconjugated hyper bilirubinaemia was defined as total serum bilirubin level that required phototherapy according to age of baby with direct bilirubin fraction <15% of total. Those who needed exchange transfusion, direct bilirubin >2mg/dl, patients who qualified for exchange transfusion during the treatment, haemolytic anaemia (positive coombs test), anaemia (haemoglobin <10mg/dl), birth asphyxia (Appearance, Pulse, Grimace, Activity, and Respiration [APGAR] score 4 at 1 min or <7 at 5 min) and neonates receiving inotropic support (intravenous [IV] dopamine or dobutamine) were excluded.

Detailed history and clinical examination was done of the subjects. Demographic details like name, age, gestational age at birth and gender were noted. The patients were divided into two groups by using computer-generated random number tables. Group A received LED light phototherapy and Group B received fluorescent light phototherapy, after covering eyes. Initially, complete blood count (CBC) with peripheral film, retic count, coombs test, blood group, serum bilirubin level, (total, direct, indirect) were sent to the hospital laboratory. Serum bilirubin was checked by bilirubinometre 6 hourly till the end of the treatment. Any high value was confirmed by serum bilirubin level and serum bilirubin done 24 hourly. Babies were observed for side-effects of phototherapy, like skin reaction and dehydration. After stopping the phototherapy, serum bilirubin was done after 24 hours to document any rebound hyperbilirubinaemia.

Data was analysed using SPSS 20. Mean and standard deviation (SD) was calculated for all quantitative variables, like age and duration of treatment. Frequency and percentage was calculated for all qualitative variables like gender. Independent sample t test was used to compare duration of treatment in both groups. P<0.05 was taken as significant. Effect modifiers, like gestational age and gender, were controlled by stratification. Post-stratification, independent sample t-test was applied.

Results

There were 460 patients divided into two equal groups of 230(50%) each. Mean age was 32.34±2.28 weeks in Group A and 32.21±2.11 weeks in Group B.

In terms of gestational age, 153(66.52%) patients in GroupA and 165(71.74%) in Group B were 29-33 weeks of gestation while 77(33.48%) in Group A and 65(28.26%) in Group B were 34-36 weeks of gestation (Table-1).

In Group A, 116(50.43%) and in Group B 120(52.17%) were boys and 114(49.57%) in Group A and 110(47.83%) in Group B were girls (Table-2).

Mean duration of treatment was recorded as 36.83±2.09

Table-1: Gestational age and Duration of treatment (in hours) (n=460).

Gestational age (in weeks)	Group-A (n=230)		Group-B (n=230)	
	Mean	SD	Mean	SD
29-33	153	66.52	165	71.74
34-36	77	33.48	65	28.26
Total	230	100	230	100
Mean±SD	32.34±2.28		32.21±2.11	
Duration (in hours)	Mean	SD	Mean	SD
P value 0.001	36.68	2.09	45.66	2.52

Table-2: Gender distribution (n=460).

Gender	Group-A (n=230)		Group-B (n=230)	
	No. of patients	%	No. of patients	%
Male	116	50.43	120	52.17
Female	114	49.57	110	47.83
Total	230	100	230	100

hours in Group A and 45.66±2.52hours in Group B (p=0.0001).

Discussion

Raised levels of serum bilirubin can cause life-threatening complications in neonates requiring management either with phototherapy or exchange blood transfusion. Most commonly used modality of phototherapy is with blue light. There are many bulbs like fluorescent tubes, halogen spotlights etc. Due to disadvantages of the available bulbs, newer methods like LEDs has been studied as an alternative as they produce low heat, has a longer life span with lower energy consumption and rapid reduction of serum bilirubin level.

The current study was planned as there is no such study available in Pakistan. However, we compared the treatment duration of LED versus fluorescent lights for unconjugated hyper bilirubinaemia in preterm neonates on a large sample size so that its results may be helpful both for patients as well as doctors in terms of decreased hospital stay, decreased financial burden on the hospital. Preterm neonates were specifically selected as this group is more prone to hyper bilirubinaemia and its complications. Feeding remained uninterrupted during phototherapy by giving expressed breast milk while babies were under phototherapy.

In this study, mean age was calculated as 32.34±2.28 weeks in Group A and 32.21±2.11 weeks in Group B, 50.43% in Group A and 52.17% in Group B were male and 49.57% in Group A and 47.83% in Group B were females, mean duration of treatment was recorded as 36.83±2.09 in Group A and 45.66±2.52 hours in Group B (p=0.001).

The results of our study coincide with recent studies from all over the world suggesting that LED phototherapy and conventional phototherapy both are effective.[12,10] In one study, treatment duration was 37.5±26.8 in patients undergoing LED phototherapy while 45.3±32.1 in patients undergoing fluorescent tube phototherapy.[11] The findings of our study are in agreement with these studies.

Another recent study[14] compared the efficacy between phototherapy equipped with LED to compact fluorescent lamp (CFL) in the treatment of neonatal hyper bilirubinemia among neonates. It comprised 50 neonates randomly allocated into two groups with almost similar characteristics between the two groups with respect to gender, type of delivery and gestational age. The mean bilirubin values (in mg/dl) among neonates in the CFL group and LED group were 14.8 and 15.6 respectively and post-24 hour values were 11.54 and 10.68 respectively. The mean difference in the reduction in the bilirubin values before andafter receiving phototherapy were significant between both groups (p<0.001). The increase in temperature was lesser among LED treatment group. They concluded that LED therapy was better than the CFL therapy as it resulted in mean reduction in the total serum bilirubin after a fixed time duration and lesser raise in temperature among the neonates.

Although most of the studies done in the past noted rare hazards in LEDs and non-LED phototherapy groups,[15] we noted an increase chances of overheating with fluorescent tubes, but it was not significant. However, all the cases were transient and we observed no serious consequences. Bertini et al. studied that conventional phototherapy units significantly increase transepidermal fluid losses in preterm infants, and this drawback was not noted in case of LED units.[16] LED phototherapy proved more beneficial than conventional phototherapy in preterm neonates in terms of better safety and efficacy, although further studies are needed in this regard. During our study, we observed no complications of phototherapy.

The findings of our study justify the hypothesis that LED light phototherapy has shorter treatment duration compared to fluorescent light phototherapy in preterm neonates with unconjugated hyperbilirubinaemia. Due to non-availability of a registration office for RCTs in Pakistan, approval was obtained from the institutional review board. Besides, no blinding was done which was a limitation.

Conclusion

Mean duration of treatment of phototherapy with LED lights was significantly shorter compared to fluorescent lights for the treatment of unconjugated hyper bilirubinaemia in preterm infants.

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Conflict of Interests: None.

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