

Management of Indirect Hyperbilirubinemia; Comparison of Complications of Light Emitting Diode (LED) and Fluorescent Phototherapy

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ABSTRACT

Objective: To compare the frequency of complications (hyperthermia, skin eruption, dehydration) of LED phototherapy and fluorescent phototherapy in management of indirect hyperbilirubinemia in neonates

Material and methods: This randomized control study was carried out from 1st June 2015 to 31 December 2016 at NNU of The Children's Hospital Lahore using Non probability consecutive sampling technique after getting informed consent from parents. All basic demographic information of each variable (name, age) was noted and entered on Performa. SPSS-18 was used to interpret the data.

Results: In our study the mean age was 1.98±0.83 days. Skin rash complication was observed in 43(13%) cases, dehydration was found in 48(14.5%) cases and hyperthermia was noted in 65(19.70%) patients.

Practical Implication: Many setups in Pakistan are still using conventional fluorescent phototherapy machines. LED has lesser side effects as compared to conventional one so by using LED light source we can lessen the adverse effects of phototherapy that will be beneficial to the babies

Conclusion: LED light source is effective for phototherapy with significantly lesser complication rate (hyperthermia, skin eruption, and dehydration) compared to fluorescent phototherapy in management of indirect hyperbilirubinemia in neonates. In this study LED phototherapy significantly showed fewer complications as compared to fluorescent phototherapy cases.

Keywords: LED, Fluorescent, Hyperthermia, Skin, Rash, Dehydration, Neonates, Hyperbilirubinemia

INTRODUCTION

Jaundice neonatorum is defined as yellow discoloration of the skin and sclera due to excess bilirubin in blood.¹ Plasma bilirubin >5mg/dl is defined as neonatal hyperbilirubinemia, and >15mg/dl as pathological hyperbilirubinemia.² Incidence of neonatal jaundice in United States is 60%.² In Iran the prevalence of hyperbilirubinemia in all neonates is 15%.³ A study conducted in Karachi showed that 13.5% of all admissions in nursery were due to jaundice in newborns.² The causes of hyperbilirubinemia in neonates are hemolytic (Rh incompatibility, ABO incompatibility), prematurity, infections, breast milk jaundice and administration of drugs such as cephalosporins.² Neonatal hyperbilirubinemia is associated with irreversible brain damage so its early diagnosis and treatment is important.⁴

To treat jaundice in newborns the most common and standard treatment option is phototherapy which can be given through different methods. The effectiveness of phototherapy depends on various factors like its range of emission, wavelength of light, amount of body area exposed. As well as irradiance which is light intensity delivered to exposed parts of body per cm². Higher this light intensity the more its effectiveness to decrease serum bilirubin level.⁴

Fluorescent tubes, halogen spotlights and LED are used as tools for phototherapy.⁵ The first two produces a lot of heat so it is not recommended to place them very near to neonate. To overcome these shortages, light-emitting diodes (LEDs) are being used as their substitutes. Their advantages are less heat production, long life span, low energy consumption and small spectral band of monochromatic light.⁶

Studies conducted in Iran and India showed that decrease in bilirubin level and phototherapy duration was comparable in LEDs and fluorescent groups.^{4,7} Hyperthermia occurred in 3.1% in LED group; however 28.1% develop hyperthermia in fluorescent groups. Two babies develop hypothermia from fluorescent group.⁴ Another study comparing the side effects of fluorescent tubes and LED phototherapy showed that percentage of hyperthermia, dehydration and skin rash was high in fluorescent group while it was low to negligible in LED group.⁸

LED phototherapy units were invented by using gallium nitrate light emitting diodes. They were expected to have higher irradiance and lesser cost. They also produce less heat have more

life span of bulbs with almost 20,000 hours while on other hand the conventional phototherapy unit has 2000 hours of life span. So in theory LED units are more superior to conventional ones.⁷

Phototherapy acts through skin to convert fat soluble bilirubin to water soluble. Because of different characteristics of skin of children of various region, the effects of phototherapy and its complications are expected to be different. To date no study comparing the effect of two different modes of phototherapy has been conducted in our country. Therefore, this study was planned to be conducted. This study will help us to choose phototherapy mode having fewer complications.

METHODOLOGY

Study Design: Randomized control trial.

Setting: NNU of The Children's Hospital & ICH, Lahore.

Duration of study: From 1st June 2016 to 31st December 2016.

Sample Size: (165 in each group) was calculated with 80% power of test, 5% level of significance and taking expected percentage of dehydration among both group i.e 8% in fluorescent tube vs 2% in LED group in management of indirect hyperbilirubinemia in neonate.

Sampling Technique: Non probability consecutive sampling

Data collection procedure: After approval from hospital ethical committee (letter attached), 330(165 in each group) patients who fulfilled the inclusion criteria were enrolled in the study from Department of neonatology CH & ICH, Lahore. Informed consent was obtained from parents/guardian. All basic demographic information of each variable (name, age) was also noted. All this procedure was done by researcher himself. All this information was recorded through pre-designed proforma. The patients were randomly allocated to two groups using random number tables, Group A and Group B. Group B was given LED and Group A was given conventional fluorescent tube phototherapy. Hyperthermia, dehydration and skin rash was checked 6 hourly respectively for 24-hour duration and recorded as per operational definition. All this information was collected through a proforma attached.

Data analysis procedure: The collected data was analyzed statistically by using SPSS version 22. Quantitative variables like age and serum bilirubin was presented in form of mean ±S.D. Qualitative variables like dehydration, hyperthermia and skin eruption were presented in the form of frequency and percentage.

Chi-square was used to compare the complication between two groups. p-value<0.05 was considered as significant. Data was stratified for gestational age, gender, skin complexion (dark/light), birth weight to deal with effect modifiers. Post stratification chi square test was applied. p-value ≤0.05 was considered significant.

RESULTS

A total of 330 neonates were included having mean age of 1.98±0.83 days with minimum and maximum age of 1 & 3 days respectively. The study results showed that the mean age of the neonates in group A was 2.01±0.83 days and its mean value in group B neonates was 1.95±0.83 days. The study results showed that the term gestational age was noted in 167 cases in which 77 were from group A and 90 were from group B, similarly the preterm gestational age was noted in 163 cases in which 88 were from group A and 75 were from group B. The ratio between male and female gender was 1.04:1.

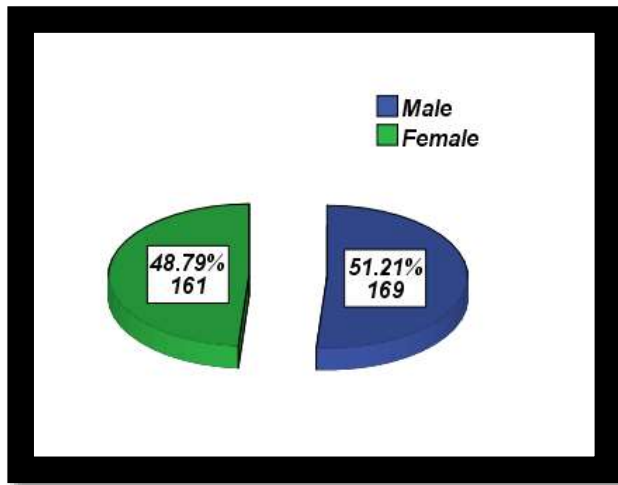


Fig 1: Gender distribution

Out of 330 cases the skin rash complication was observed in 43(13%) cases. Out of 330 cases the dehydration complication was found in 48(14.5%) cases. In our study the hyperthermia complication was noted in 65(19.70%) patients. The study results showed that the out of 43 cases, 31 were from group A while rest were from group B. Out of 330 cases, 287 did not develop skin rash and 134 from these were in group A while 153 were in group B.

Table 1: Comparison of skin rash

	Study Groups		χ ²	Sig.	Total
	Group A	Group B			
Skin rash	Yes	43	9.653	.000	43
	No	287			
Total		165			330

Note: Group A= Fluorescent phototherapy, Group B= LED phototherapy

Dehydration was found in 48 babies; 32 babies were in group A and 16 were in group B. Dehydration. From group A, 133 babies and from group B 149 babies did not suffered from dehydration. Significance value was 0.012 between both groups which was significant statistically.

Table 2: Comparison of Dehydration

	Study Groups		χ ²	Sig.	Total
	Group A	Group B			
Dehydration	Yes	16	6.24	0.012	48
	No	149			
Total		165			330

Note: Group A= Fluorescent phototherapy, Group B= LED phototherapy

Hyperthermia was present in 65 babies, 43 belong to group A while 22 from group B. Hyperthermia was not present in 265 babies ,122 in group A and 143 in group B.

Table 3: Comparison of Hyperthermia

	Study Groups		χ ²	Sig.	Total
	Group A	Group B			
Hyperthermia	Yes	22	8.45	.004	65
	No	143			
Total		165			330

Note: Group A= Fluorescent phototherapy, Group B= LED phototherapy

DISCUSSION

With advancement in phototherapy, studies done to check the efficacy of both LED and conventional phototherapy have variable results. This study was conducted at NNU of The Children’s Hospital & ICH, Lahore to compare the frequency of complications (hyperthermia, skin eruption, dehydration) of LED phototherapy and fluorescent phototherapy in management of indirect hyperbilirubinemia in neonates.

Efficacy of phototherapy for treatment of jaundice can be affected by many factors of the light source. As routinely used phototherapy machines produce more heat and have unstable wavelength output LED units are used as substitution as they produce less heat, utilize less energy, produce narrow wavelength high-intensity light and has prolong life span.^{9,10}

In our study the skin rash complication was observed in 43(13%) cases, dehydration was found in 48(14.5%) cases and hyperthermia was noted in 65(19.70%) patients. In this study LED phototherapy significantly showed fewer complications (skin rash, dehydration & Hyperthermia) as compared to fluorescent phototherapy cases.

According to Majid Mohammadzadeh et al³ LED light source and fluorescent tubes are equally effective for phototherapy. Hyperthermia was present in 3.1%(LED group) and 28.1% (fluorescent groups) of patients.

Another study by Praveen Kumar et al⁶ presented that LED light and conventional phototherapy are equally effective in decreasing bilirubin level and adverse effects like skin rash ,hypo and hyperthermia were rare and occurred with same ratio in both groups.

A study done by Bertini and colleagues showed that there was notable increase of trans epidermal water loss in preterm infants with conventional phototherapy however; it was not observed with LED units.¹¹ T Raghunath Reddy et al¹² demonstrated in their study that LED phototherapy units are more efficacious in terms of higher rate of fall of bilirubin levels in similar time duration compared to CFL units.

Martin et al.¹³ study also showed that LED group resulted in a better efficacy. Study done by J.Viau Colindres et al¹⁴ found that LED lights were equally effective as conventional phototherapy. Another study comparing the side effects of fluorescent tubes and LED phototherapy, LED has lower rates of hyperthermia, dehydration and skin rash as compared to conventional phototherapy.⁸

A study done by Karagol BS et al. stated that LED phototherapy decreases bilirubin level more quickly as compared to other modalities with lesser side effects.¹⁵

A study done by EK-isariyaphorn R et al. find out that conventional phototherapy is less productive in the reduction of serum bilirubin level and hyperthermia is more common as compared to LED.¹⁶

A study by Praveen Kumar stated that adverse effects of phototherapy like hyperthermia and skin rash were not common and developed with equal number in both LED and conventional groups.¹⁷

A study done by Hanan S Sherbiny concluded that side-effects were like hyperthermia, dehydration and skin rash were more in fluorescent tubes-treated group.¹⁸

Another study conducted by Şahin Takcı showed that hyperthermia and skin rash was more in patients with fluorescent phototherapy as compared to LED one.¹⁸

CONCLUSION

LED light source is effective for phototherapy with significantly lesser complication rate (hyperthermia, skin eruption, and dehydration) compared to fluorescent phototherapy in management of indirect hyperbilirubinemia in neonates.

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