Evaluation of the benefits and efficacy of light emitting diode (LED) device with respect to conventional fluorescent tube phototherapy device in neonatal hyperbilirubinemia in near term and full term neonates

Murmu M.C., Das L., Suneer C.M.

1Dr. Mangal Charan Murmu, Assistant Professor, 2Dr. Leena Das, Associate Professor, 3Dr. Suneer C.M., Resident Physician, all authors are affiliated with Department of Pediatrics, S C B Medical College, Cuttack, Odisha, India.

Address for Correspondence: Dr. Mangal Charan Murmu, E-mail: mangal74murmu@yahoo.co.in

Abstract

Introduction: Neonatal jaundice is a common, in most cases a benign problem in neonates. About 60% of term and 80% of preterm babies develop jaundice during the first week of life. About 5-10% of all newborns need phototherapy for this commonest morbidity in neonatal life. The commonly used light sources are special blue fluorescent tubes, compact fluorescent tubes and halogen spotlights. In recent years a new type of light source light emitting diodes (LED) has been incorporated into phototherapy. Methodology: Hospital based prospective and observational study. The study was done over a period of two years in SNCU, NICU and Newborn ward, department of paediatrics, S.C.B. Medical College, Cuttack from September 2014 to August 2016. Investigation were done in the department of pathology, biochemistry and central laboratory. Results: The duration of phototherapy was shorter in patients who received LED phototherapy than those treated with conventional phototherapy. The children receiving LED phototherapy has less weightloss compared to conventional phototherapy. There is 12% extra loss of weight during phototherapy in children with conventional phototherapy. Rebound hyperbilirubinemia was more in children treated with LED Phototherapy as compared to 8% of conventional phototherapy. Side effects are more in conventional phototherapy. Conclusion: LED is safe rescue treatment for severe neonatal hyperbilirubinemia and its implementation reduce the failure of phototherapy and need for exchange transfusion.

Keywords: Phototherapy, Kernicterus, Hyperbilirubinemia

Introduction

Hyperbilirubinemia is defined as the increase in serum bilirubin level in circulation. Jaundice attributable to physiological immaturity of neonates to handle increased bilirubin production is termed as physiological jaundice. Visible jaundice usually appears between 24 to 72 hours of life. TSB (Total Serum Bilirubin) levels usually rises in term infants to a peak level of 12 to 15 mg/dl by 3 Days of life and than fall. In preterm babies, the peak level occurs on the 3to 7 days of age and TSB can rise over 15mg/dl.Pathological jaundice is said to be present when TSB concentrations are not in physiological jaundice range, which is defined arbitrarily and loosely as more than 5mg/dl on first day, 10mg/dl on second day and 12-13 mg/dl thereafter in term neonates. Any bilirubin value of 17mg/dl or more should be evaluated for the cause and possible intervention, such as phototherapy [7,8]. About 60% of term and 80% of preterm babies develop jaundice during the first week of life [1,2]. About 5-10% of all newborns need phototherapy for this commonest morbidity in neonatal life [3]. Premature babies have much higher incidence of neonatal jaundice requiring therapeutic intervention more commonly than the term newborns [4]. Although the outcome for the majority is benign, infants with untreated, severe hyperbilirubinemia (defined as serum bilirubin level>20mg/dl) can develop signs of Acute bilirubin...
encephalopathy (ABE). Management of hyper-
bilirubinemia includes detection of at risk neonates,
investigating the cause of pathological hyper-
bilirubinemia, deciding the thresholds for starting and 
stopping treatment and follow-up of neonates with 
severe hyperbilirubinemia [5].

Common risk factors for pathological unconjugated 
a jaundice include blood group incompatibility, glucose-
6-phosphate dehydrogenase enzyme deficiency,
prematurity, instrumental delivery and non-optimal 
breastfeeding. A direct relationship between severe 
unconjugated hyperbilirubinemia and neurological 
damage has been demonstrated. Acute bilirubin 
encephalopathy is caused by the toxic effects of 
unconjugated bilirubin on the central nervous system.

A morbidity which if untreated, may progress rapidly to 
advanced manifestations such as opisthotonous and 
seizures. Intervention such as exchange blood 
transfusion and phototherapy aim at reducing the serum 
bilirubin in order to prevent bilirubin brain toxicity 
[9]. Understanding the dose response effect and other 
factor that influence the way light works to lower the 
bilirubin levels has led to the effective use of 
phototherapy and has eliminated the need of exchange 
transfusion in all most all jaundiced infants [11]. The 
efficacy of phototherapy depends upon wavelength 
irradiance, exposed body surface area, distance of photo 
therapy and duration of exposure. Intensive 
phototherapy is provided by use of high levels of 
irradiance in the 430 to 490 nm band (usually 30 µW/cm 
sq/nm or higher) delivered to as much of infant’s body 
surface area as possible [14].

The commonly used light sources are special blue 
fluorescent tubes, compact fluorescent tubes and 
halogen spotlights [13,14]. In recent years a new type of 
light source light emitting diodes (LED) has been 
incorporated into phototherapy. LEDs are power 
efficient, portable device with low heat production so 
that it can be placed very close to the skin of the baby 
without any apparent untoward effects. They are 
durable light sources with average life span of 20,000 
hours [17]. Blue LEDs have a narrow spectral band of 
high intensity monochromatic light that overlaps the 
absorption spectrum of bilirubin [17]. The unique 
characteristics of LEDs make them attractive light 
source for an optimal phototherapy unit.

The present study is to evaluate efficacy of LED 
phototherapy in comparison with conventional 
phototherapy in the management of neonatal 
hyperbilirubinemia and to compare its side effects and 
ability to prevent exchange transfusion, to compare the 
comfort level of staff during photo therapy.

Aim- To evaluate the benefits and efficacy of light 
emitting diode (LED) with respect to conventional 
fluorescent tubes phototherapy device in management 
of neonatal hyperbilirubinemia in term and near term 
newborns.

Objectives- To evaluate the benefits of LED 
phototherapy as compared to conventional photo 
therapy in decreasing serum total bilirubin level and 
duration of treatment with unconjugated 
hyperbilirubinemia during the first 28 days of life.

Sample Size- 200 Newborn babies

Selection of Babies- All the newborn babies who were 
admitted in the neonatal wards of paediatrics 
department at S C B Medical College& SVPPGIP, 
Cuttack, full filling the inclusion criteria were examined 
& investigated in detail and necessary data was noted in 
a pre-designed Performa.

Inclusion criteria
1. Gestational age >35 weeks 
2. Birth weight >2kg 
3. Post natal age less than/equal to 28 days

Exclusion criteria
1. Gestational age <35 weeks 
2. Birth weight <2kg 
3. Newborns with ABO or Rh incompatibility 
(Pathological jaundice) 
4. Neonates without sepsis & birth asphyxia 
5. Babies more than 28 days of life

Materials and Methods

This study is Hospital based prospective and observational study. The study was done over a period of two years in 
SNCU, NICU and Newborn ward of department of paediatrics, S.C.B. Medical College, Cuttack from September 2014 to 
August 2016. Investigation were done in the department of pathology, biochemistry and central laboratory.
All the babies were appropriate for gestational age (AGA) and with normal finding on physical examination. Babies with normal blood count and peripheral smear, no evidence of blood group isoimmunisation, negative direct coomb test (DCT), normal reticulocyte count and normal enzyme activities are taken for study.

Out of two hundred newborns, 100 newborns are treated with conventional phototherapy (Group 1). were taken by assessing the values with hour specific Bhutani’s nomogram. Visible icterus was evaluated by using Kramer’s rule. The skin colour of baby was elicited by using Felix Von Luschan skin colour scale. All the neonates were followed till the baby was present in the hospital i.e. recovery or discharged otherwise (LAMA/DAMA/DEATH).

The newborns are placed in open cribs undressed except for diaper and had eyes covered, interrupted only for feeding, cleaning and blood test. In both groups distance of baby from phototherapy unit was matched. Conventional phototherapy was utilised in group 1 at a distance of 40cm. LED device was also kept at distance of 40cm. The conventional fluorescent phototherapy unit we used is NEOTECH, MEDITRIX phototherapy unit. The LED system is BRILLIANCE LED SYSTEM, D REV PHOENIX Obelis s a, Boulevard General wahs 53,1030 brussels.

The irradiance of phototherapy units at surface are measured at the level of face, xiphoid and knees by photoradiometer.(THOR MULTIESTER MOD3620FANEM BRASIL). Laboratory examinations included total and direct serum bilirubin at the time of enrolment, blood groups of the newborn and the mother, blood test for hemolysis, unusually shaped red cell, or evidence of infection and test for G6PD deficiency.

Venous sampling for serum bilirubin is done at 8, 24 and 48 hours. The values are compared with transcutaneous bilirubin level which is taken using a DRAGER-JM103 transcutaneous bilirubinometer over the covered area. Axillary body temperature was measured every 4 hours.

The present study is an attempt to evaluate the efficacy of LED Phototherapy with respect to conventional phototherapy and the benifits like preventing exchange transfusion, decreasing side effects and its role in management of neonatal hyperbilirubenimia.

Observation

Table-1: Gestatinal age and sex distribution in our study (n =200).

| Gestational age | Boy baby | Girl baby | Total |
|-----------------|----------|-----------|-------|
| Late pre term   | 12       | 20        | 32    |
| Term            | 108      | 60        | 168   |
| Total           | 120      | 80        | 200   |

Out of two hundred newborn 168(84%) were term and remaining were late preterm as shown in table 1. Boy baby were 120 (60%) and girl baby were 80 (40%) with a boy to girl ratio 1.5:1

Table-2: Postnatal age of presentation to hospital and day of onset of jaundice.

| Day of life | Admission ( no of babies) | Onset of jaundice(no of babies ) |
|-------------|---------------------------|----------------------------------|
| Less than 24 hours | Nil                       | nil                              |
| 24-48 hours   | 68 (34%)                  | 50(25%)                          |
| More than 48 hours | 132 (66%)               | 150 (75%)                        |

The mean age of presentation to hospital 51.89 +/- 4.5 hours with a majority 132 (66%) babies brought to the hospital after 48 hrs of post natal life followed by 68 (43%) babies admitted between 24-48 hours as shown in table 2. Most of the babies developed jaundice after 48 hours, 150 cases (75%), 50 cases (25%) developed jaundice between 24-48 hours. There is no case with jaundice developed less than 24 hours.
Table -3: Kramer’s grading at the time of admission.

| Kramer’s stage | number of babies |
|----------------|------------------|
| III            | 14               |
| IV             | 102              |
| V              | 84               |
| Total          | 200              |

At presentation 102 (51%) babies had Kramer stage IV for jaundice followed by 84(42%) with stage V jaundice and remaining 14 (7%) have stage III jaundice.

Table-4: Demographical, clinical and laboratory characteristics.

| Parameter | Conventional group | LED Group |
|-----------|--------------------|-----------|
| Mean gestational age in week | 38.76 +/-1.13 | 38.38+/-1.14 |
| Gestational age range in week | 35-41 | 35-41 |
| Mean weight at initiation of phototherapy in grams | 2772+/-227 | 2719+/-282 |
| Mean weight at stoppage of phototherapy in grams | 2610+/-197 | 2576+/-276 |
| Mean weight loss in grams | 161 +/-110 | 142 +/-41 |
| Mean post natal age at admission in hours | 52.22+/-4.8 | 51.56+/-4.2 |
| Mean postnatal age at development of jaundice in hours | 52.58+/-5.10 | 52.84+/-3.74 |
| Mean time of initiation of phototherapy in hours | 52.58+/-5.10 | 52.84+/-3.74 |
| Mean initial bilirubin in mg /dl | 17.38+/-1.17 | 18.88+/-1.04 |
| Mean bilirubin at 8 hour in mg/dl | 16.80+/-1.44 | 15.06+/-1.73 |
| Mean bilirubin at 24 hour in mg/dl | 16+/-2.17 | 14.62+/-1.73 |
| Mean bilirubin at 48 hour in mg/dl | 14.88+/-3.99 | 12.48+/-2.80 |
| Mean bilirubin at stoppage in mg/dl | 12.92+/-3.6 | 12.26+/-2.84 |
| Mean duration | 60.68+/-16.9 | 50+/-2.58 |
| Fall of bilirubin in mg dl/hr | 0.058+/-0.03 | 0.137+/-0.04 |
| Relative change in bilirubin at 8hour (%/hr) | 0.41+/-0.2 | 1.2+/-0.5 |
| Relative change in bilirubin at 48hour (%/hr) | 0.29+/-0.3 | 0.74+/-0.3 |
| Rebound jaundice in number | 8 | 12 |
| Relative change in bilirubin at 8hour (%/hr) | 20 | 6 |
| Mean irradiance (µW/cm square /nm) | 18.04+/-1.40 | 36.34+/-1.13 |
| Side effect in number | 20 | 12 |
| Comfort Likerts scale | 20 % | 80% |

As shown the table LED over score conventional florescent phototherapy in each and every respect.

Table-5: Gestational age of study group.

| Gestational age in weeks | TYPE | N | MEAN (week) | Std. deviation | Std. Error mean | t and p value |
|--------------------------|------|---|-------------|----------------|-----------------|--------------|
| LED                      | 100  | 38.38 | 1.14        | 0.101          | t=1.67          | df=97.99, p=0.098 |
|                          |      |      |             |                |                 |              |
| Conventional             | 100  | 38.76 | 1.135       | 0.101          |                 |              |

In this study we allotted 100 newborn babies to LED group with an average gestational age of 38.38+/- 1.14 weeks and 100 to conventional group with average gestational age of 38.76+/-1.135 weeks. Gestational age is compared by dividing the babies into two groups LED and conventional and independent t test was applied to find out the statistical difference. The test shows gestational age did not have any statistical difference in child with LED and conventional phototheray.
We allotted 100 newborn babies each into LED and Conventional phototherapy group with LED group having mean postnatal age of admission 51.56 +/-4.20 hours and conventional group having mean postnatal age of 52.22+/ -4.87 hours. Postnatal age was compared in both the groups and the statistical difference was measured by independent t test. It shows that the postnatal age had no statistical difference in both the age group.

There is no statistical difference in the time of phototherapy (t=0.290, p=0.772) but there is significant statistical difference in the time of stoppage (t=4.091, p=0.001) and duration (t=4.313, p=0.001) of phototherapy in both the groups.

### Table-6: Post natal age of admission.

| postnatal | Type     | N  | Mean hours | Std. deviation | Std. Error mean | t and p value |
|-----------|----------|----|------------|----------------|-----------------|---------------|
| Age       | LED      | 100| 51.56      | 4.200          | 0.594           | t=0.726       |
|           | Conventional | 100| 52.22      | 4.871          | 0.689           | df=95.93, p=0.470 |

### Table-7: Time of initiation, stoppage and duration of phototherapy.

| Time                  | LED     | Conventional | difference | t and p value |
|-----------------------|---------|---------------|------------|---------------|
| Time of initiation in hours | 52.84   | 52.58         | 0.260      | t=0.290, df=89.95, p=0.772 |
| Time of stoppage in hours | 102.84  | 113.26        | 10.420     | t=4.091, df=54.076, p=0.002 |
| Duration of phototherapy in hours | 50      | 60.68         | 10.680     | t=4.413, df=51.291, p=0.001 |

### Table-8: Fall of bilirubin during phototherapy.

| Hrs of phototherapy | Type     | N  | Mean | Std. deviation | Std. Error mean | t and p value |
|---------------------|----------|----|------|----------------|-----------------|---------------|
| Bilirubin at initiation (mg/dl) | LED | 100 | 18.8 | 1.043          | 0.147           | t=6.748, df=96.614, p=0.081 |
| Conventional       | 100     | 17.9 | 1.176 | 0.166          |                 |               |
| Bilirubin at 8hrs (mg/dl) | LED | 100 | 15.06 | 1.038          | 0.147           | t=1.034, df=89.01, p=0.03 |
| Conventional       | 100     | 16.8 | 1.443 | 0.204           |                 |               |
| Bilirubin at 48hrs (mg/dl) | LED | 100 | 12.48 | 2.808          | 0.397           | t=3.485, df=88.129, p=0.001 |
| Conventional       | 100     | 14.88 | 3.978 | 0.563           |                 |               |
| Bilirubin at stoppage (mg/dl) | LED | 100 | 12.26 | 2.841          | 0.402           | t=4.088, df=92.779, p=0.1 |
| Conventional       | 100     | 12.92 | 3.619 | 0.512           |                 |               |
| Fall of bilirubin (mg/dl/hr) | LED | 100 | 0.137160 | 0.045698      | 0.006462        | t=9.713, df=91.725, p=0.002 |
| Conventional       | 100     | 0.058122 | 0.034963 | 0.004944      |                 |               |
The mean bilirubin at initiation of phototherapy is 18.8 +/- 1.04 mg/dl in LED group and 17.9 +/- 1.17 mg/dl in conventional group and bilirubin level at 8 hours is 15.06 +/- 1.04mg/dl in LED group and 16.80 +/- 1.44mg /dl in conventional group, while the bilirubin at 48 hours is 12.48 +/- 2.80mg/dl in LED group and 14.88 +/- 3.97 mg/dl in conventional group. The bilirubin at stoppage is 12.26 +/-2.841mg/dl and 12.92 +/- 3.619mg/dl in both groups. The fall of bilirubin is 0.1371 +/-0.0456mg/dl/hour in LED group and 0.0581 +/-0.004mg/dl/hr in conventional group. There is no significance difference in the case of bilirubin at initiation and bilirubin at stoppage since the p value is more than 0.05 as seen in the bilirubin at 8, 48 hours;and the fall of bilirubin shows a definite statistical difference between LED and conventional group (p value<0.05).

Table-9: Irradiance of phototherapy.

| Irradiance in µW/cm square /nm | Type     | N   | Mean    | Std. deviation | Std. Error mean | T and p value |
|-------------------------------|----------|-----|---------|----------------|-----------------|---------------|
|                               | LED      | 100 | 36.3460 | 1.13573        | 0.1606          | t=71.695      |
|                               | CONVENTIONAL | 100 | 18.0400 | 1.40349        | 0.1984          | df=93.914     |

The mean iradiance of LED phototherapy unit is 36.35 +/-1.13 where as in conventional fluorescent phototherapy unit is by using THOR 3620 Flux meter. Comparing the irradiance of LED phototherapy unit and conventional fluorescence tube phototherapy unit there is a significant statistical difference (t=71.69, p=0.0001)

Table-10: Weight loss during phototherapy.

| Weight at initiation in grams | Type     | N   | Mean    | Std. deviation | Std. Error mean | t and p value |
|-------------------------------|----------|-----|---------|----------------|-----------------|---------------|
|                               | LED      | 100 | 2719    | 282.642        | 39.972          | t=1.033       |
|                               | Conventional | 100 | 2772    | 227.713        | 32.203          | df=93.75      |
|                               |          |     |         |                |                  | p=0.304       |
| Weight at stoppage in grams   | LED      | 100 | 2576    | 276.642        | 39.123          | t=0.750       |
|                               | Conventional | 100 | 2611    | 197.370        | 27.912          | df=92.618     |
|                               |          |     |         |                |                  | p=0.478       |
| Weight loss in grams          | LED      | 100 | 142     | 41.699         | 5.897           | t=1.069       |
|                               | Conventional | 100 | 161     | 110.583        | 15.639          | df=90.658     |
|                               |          |     |         |                |                  | p= 0.06       |

The weight at initiation in LED group and conventional group is 2719 +/-282.64 and 2772 +/-227.71g respectively. The weight at stoppage is 2576 +/-276.64g and 2611 +/-197.37g in both groups. Hence the mean weight loss is 141 +/-1.699g and 161 +/-110.583g in both group respectively. There is no significant difference regarding the weight of the babies during initiation and stoppage of phototherapy groups ( t=1.033 and p= 0.304, t=0.750 and p=0.06). Even the weight loss is more during conventional phototherapy, there is no definite statistical difference.

Table-11: Rebound hyperbilirubinemia.

| Type    | N   | Rebound | p and t values |
|---------|-----|---------|----------------|
| LED     | 100 | 12      | t=0.887        |
| Conventional | 100 | 8       | df=94.30       |
|          |     |         | p=0.38         |

Out of 100 babies treated with LED phototherapy 12 babies have rebound hyperbilirubinimia as compared to 8 in conventional phototherapy. There is significant between both group since the p value is 0.38.
There is total number of 20 failure in conventional phototherapy, sixteen of them going for DSPT and four out of them going for exchange transfusion. In LED group there is only six failures all going for DSPT. There is a significant difference in failure of phototherapy between both group.

| TYPE         | N  | Failure                        | p and t value |
|--------------|----|--------------------------------|---------------|
| LED          | 100| Exchange transfusion           | 0             |
|              |    | DSPT                           | t= 2.107      |
|              |    |                               | df=79.729     |
|              |    | Conventional                  | p=.003        |
| Conventional | 100| Exchange transfusion           | 4             |
|              |    | DSPT                           |               |
|              |    |                               |               |

The LED group total of about twelve babies developed some side effect while in conventional group about twenty babies developed side effects showing p value 0.140. so there is no significant statistical difference. In LED group there is no case of hyperthermia, while 2 babies developed hypothermia (2%). There are no case of dehydration, while four babies developed rash (4%). In conventional group they developed four cases of hyperthermia (4%), five cases of rashes (5%) and one case of dehydration (1%), irritability and excessive crying is more in conventional (10%) than LED (6%).

Out of total 200 staff (nursing staff and doctors) 160 favoured LED phototherapy. Here we got the p value 0.012 and is statistically significant.

**Discussion**

Out of 200 newborns included in our study, 68(84%) babies were term and remaining 32(16%) babies were late preterm with baby boy being 120 (60 %) and girl baby 80(40%) and M:F ratio 1.5:1 as shown in table 1. This might not be true as study includes only term and late pre term babies. Recent review by Cochrane includes both term and preterm babies, which is different from our study. The study conducted by Majid Mohammadizadeh [21]in Iran in 2012 includes only preterm neonate. The average age of gestation in babies treated with LED phototherapy is 38.38+/−1.14 weeks and conventional group is 38.76+/−1.13 weeks. Similar results were observed by other authors [28,29]. Table 2 shows the mean age of presentation to the hospital 51.89+/−4.5 hours with majority 132(66%) babies brought to hospital after 48 hours of post natal life.
followed by 68(38%) babies between 24-48 hours[10]. The average post natal age of presentation in LED group is 51.56+/4.871 hours, a study by Martin 2007 have similar results [19,20]. There is significant difference in time of stoppage (t=4.091,p=0.002) and duration of phototherapy ( t =4.431,p=0.001) while comparing LED with conventional group as shown in table -10. The study shows duration of phototherapy with LED is much lower. Similar results were observed by other authors [19,21,22,26].

The mean bilirubin at the time of initiation and stoppage was almost similar in two groups, there by indicating that uniform guidelines was followed for starting and stopping of phototherapy. This is in accordance with Kumar et al [28]. LED phototherapy might be useful in treating severe hyperbilirubinemia and there by preventing its complications [19,20,23,24]. The average irradiance of LED in our study is 36.34+/1.35µW/cm square /nm which was below reported level according to Tan et al [27].

The rebound hyperbilirubinemia is more in LED as compared to conventional, this is against Belma et al[23], Seidman 2003[23]. The weight loss during phototherapy is more in conventional group (161+/110gms) than LED group (142/41.699gms), this is comparable with Kumar et al 2009[28], uras et al 2009[29].The study shows that LED phototherapy re more efficient in preventing failure of phototherapy and exchange transfusion, which is same as study done by kumar et al 2010[19] and martins 2007[21]. Uras et al 2009 studied that there were no failure of phototherapy in both LED and conventional group [29]. In our study, in LED group 12 percent children developed any type of side effect against a 20 percent of side effects in babies treated with conventional phototherapy, it is similar to study conducted by Kumar 2010[19] and Martins [21]. In our study which is Likert scale study, out of 200 newborn babies treated with phototherapy about 80% show more comfort with LED phototherapy while only 20% opts for conventional phototherapy. It shows a definite statistical difference since more opting for LED phototherapy [p=0.012].The study is similar with study done by Seidman et al [23,24].

**Conclusion**

Jaundice usually becomes clinically apparent to parents by zone IV and hence need immediate treatment to prevent kernicterus. This can be achieved by institution of proper proper phototherapy more device. LED phototherapy is more efficacious in bringing down the serum bilirubin level. The rate of fall of bilirubin is more with LED phototherapy unit than conventional fluorescent tube phototherapy unit. The maximum fall of bilirubin is during initial phase of phototherapy. LED Phototherapy unit have twice the irradiance of conventional phototherapy unit. LED is safe rescue treatment for severe neonatal hyperbilirubinemia and its implementation reduce the failure of phototherapy and need of exchange transfusion.

LED phototherapy device has caused less frequent side effects and there was no acute severe side effects. It produces less heat and dehydration so can be placed very close to the newborn. Moreover LED phototherapy unit provide more nursing comfort as compared to the conventional phototherapy unit. Only draw back with of LED with our study it causes rebound jaundice. Hence LED could be a resourceful technique in view of its efficacy and least side effects and cost effectiveness.

**Abbreviations**

ABE: Acute bilirubin encephalopathy, NIND: Neurological induced neurological dysfunction, C F T: Compact fluorescent tube, DSPT: Double surface phototherapy, g/dl: gram per deci liter, i.e.: that is, LED: light emitting Diode, Kg: kilogram, LAMA: Left against medical advice, N: Number of cases/observation, NNHB: Neonatal hyper bilirubinemia, S: Serum, T S B: Total serum bilirubin, %: percentage, &: and, µmol/L: Micro mol per litre, µW/cm square /nm: micro watt per centimetre square per nanometer.

**Funding:** Nil. **Conflict of interest:** None initiated, **Permission from IRB:** Yes

**References**

1. Rishikes Thakre. Neonatal hyperbilirubinemia. In IAP Textbook of paediatrics, 5th edition, print: newdelhi, ISBN: 978-93-5025-945-0. jaypee brothers medical publishers, ch2,72013 page 41-44.

2. N Ambalavanan, W A Carlo. kliegman, Stanton, St. Gene et al jaundice and hyperbilirubinemia in newborn, nelson text book of paediatrics 19th ed, print newdelhi ISBN : 9781437707557. Saunders-Elsevier publication 2012 reprint ch 96.3 pages 603-12.

3. Kivlahan C, James EJ. The natural history of neonatal jaundice. Pediatrics.1984 Sep;74(3):364-70.
4. Narang A, Kumar P, Kumar R. Neonatal jaundice in very low birth weight babies. Indian J Pediatr. 2001 Apr;68(4):307-9.

5. NNF clinical practice guidelines. Management of Neonatal hyperbilirubinemia 2012 page 139-154.

6. Madan A, Mac Mohan JR, Stevenson DK. Neonatal Hyperbilirubinemia. In Taeush HW, Ballard RA, Gleason CA, eds. Avery’s Diseases of the Newborn, 8th ed. Philadelphia; WB Saunders, 1226–1256.

7. Maisels MJ, Giford K. Normal serum bilirubin levels in the newborn and the effect of breast-feeding. Pediatrics. 1986 Nov;78(5):837-43.

8. Rennie J, Burman-Roy S, Murphy MS; Guideline development group. Neonatal jaundice: summary of NICE guidance BMJ 2010 May 19;340:c2409. doi:10.1136/bmj.c2409

9. Juretschke LJ. Kernicterus: still a concern. Neonatal Netw. 2005 Mar-Apr;24(2):7-19.

10. Bhutani VK, Johnson LH, Keren R. Diagnosis and management of hyperbilirubinemia in the term neonate: for a safer first week. Pediatr Clin North Am. 2004 Aug; 51(4):843-61, vii.

11. McDonagh AF. Phototherapy: from ancient Egypt to the new millennium. J Perinatol. 2001 Dec;21 Suppl 1:S7-S12.

12. Ennever JF. Bluelight, greenlight, whitelight, morelight: treatment of neonatal jaundice. Clin Perinatol. 1990 Jun;17(2):467-81.

13. Maisels MJ. Phototherapy--traditional and nontraditional. J Perinatol. 2001 Dec;21 Suppl 1:S93-7; discussion S104-7.

14. American academy of paediatrics: management of hyperbilirubinemia in the newborn infant 35 or more weeks of gestation. Pediatrics 2004; 297-316.

15. Mills JF, Tudehope D, Fibroptic phototherapy for neonatal Jaundice. Cochrane database of systematic reviews 2001, issue. Art No:CD002060.D01:10.1002/14651858.CD002060.

16. Tan KL. Efficacy of fluorescent daylight, blue, and greenlamps in the management of nonhemolytic hyperbilirubinemia. J Pediatr. 1989 Jan;114(1):132-7.

17. Vreman HJ, Wong RJ, Stevenson DK, Route RK, Reader SD, Fejer MM, Gale R, Seidman DS. Light-emitting diodes: a novellightsource for phototherapy. Pediatr Res. 1998 Nov;44(5):804-9.

18. Bertini g, Perugi S, Elia S, Pratesi D, Dani S, Rubaltelli FF. Transepidermal water loss and cerebral hemodynamics in preterm infants; Conventional versus LED phototherapy. European journal of paediatrics 2008;167(1):37-42.

19. Kumar P, Murki S, Malik GK, Chawla D, Deorari AK, Karthi N, Subramanian S, Sravanthi J, Gaddam P, Singh SN. Light emitting diodes versus compact fluorescent tubes for phototherapy in neonatal jaundice: a multicenter randomized controlled trial. Indian Pediatr. 2010 Feb;47(2):131-7. Epub 2009 May 20.

20. Maisels MJ, Kring EA, DeRidder J. Randomized controlled trial of light-emitting diode phototherapy. J Perinatol. 2007 Sep;27(9):565-7. Epub 2007 Jun 28.

21. Majid Mohammadizadeh, Fereshteh Kadkhodaei Eliadarani, Zohreh Badiei, Is the light-emitting diode a better light source than fluorescent tube for phototherapy of neonatal jaundice in preterm infants? Advanced Biomedical Research 2012, 1: 51

22. Martins BM, de Carvalho M, Moreira ME, Lopes JM. Efficacy of new microprocessed phototherapy system with five high intensity light emitting diodes (Super LED). J Pediatr (Rio J). 2007 May-Jun;83(3):253-8.

23. Seidman DS, Moise J, Ergaz Z, Laor A, Vreman HJ, Stevenson DK, Gale R. A new blue-light-emitting phototherapy device: a prospective randomized controlled study. J Pediatr. 2000 Jun;136(6):771-4.

24. Seidman DS, Moise J, Ergaz Z, Laor A, Vreman HJ, Stevenson DK, Gale R. A prospective randomized controlled study of phototherapy using blue and blue-green-emitting devices, and conventional halogen-quartz phototherapy. J Perinatol. 2003 Mar; 23(2):123-7.

25. Phyllis A Dennary, Daniel S Siedman, David K Stevenson. Neonatal hyperbilirubinemia. New England journal of Medicine Feb 2001;344(8):581-589.
26. Dani C, Martelli E, Reali MF, et al. Fiberoptic and conventional phototherapy effects on the skin of premature infants. J Pediatr 2001;138:438-40

27. Belma Saygli Karrogoi, Omer Erdeve; Efficacy of LED Phototherapy in comparison with conventional phototherapy in neonatal jaundice, journal of Ankara university faculty medicine 2007;60(1):30-32

28. Tan KL. The pattern of bilirubin response to phototherapy for neonatal hyperbilirubinemia. Pediatr Res. 1982 Aug;16(8):670-4.

29. Kumar et al 2009. Light emitting diodes versus compact fluorescent tubes for phototherapy in neonatal jaundice:A multi center randomised controlled trial. Light source of phototherapy:volume47pg132-136.

30. Nurdan Uras, Ahmet Karadag; Comparison of light emitting diode phototherapy and double standard conventional phototherapy for non heamolytic neonatal bilirubinemia. Turk J Med Sci. 2009;39(3):337-341.

31. Zohreh Badiee, Majid Mohammadizadeh, Masih Shamee Diagnostic usefulness of transcutaneous bilirubinometry in very preterm newborns Int J Prev Med 2012;4:262-5.

How to cite this article?
Murmu M.C, Das L, Suneeer C.M. Evaluation of the benefits and efficacy of light emitting diode (LED) device with respect to conventional fluorescent tube phototherapy device in neonatal hyper bilirubinemias in near term and full term neonates. J PediatrRes.2017;4(05):333-342.doi:10.17511/ijpr.2017.i05.08