

# A Comparative Analysis of Intermittent and Continuous Phototherapy in Patients with Neonatal Jaundice

Shereen Mari <sup>a</sup>, Shazia Memon <sup>b#</sup>, Muhammad Nadeem Chohan <sup>b\*†</sup>,  
Muhammad Touseef <sup>c‡</sup>, Saroop Chand <sup>c‡</sup> and Chetan Das <sup>c#</sup>

<sup>a</sup> Resident Pediatrics LUMHS Jamshoro, Pakistan.

<sup>b</sup> Pediatrics Department, LUMHS, Pakistan.

<sup>c</sup> Pediatrics, LUMHS, Jamshoro, Pakistan.

Original Research Article

## ABSTRACT

**Aim:** To compare the outcome of intermittent phototherapy versus continuous phototherapy in treatment of neonatal jaundice.

**Study Design:** Randomized clinical trial (RCT).

**Place and Duration:** This study was conducted at Department of pediatrics, neonatal ward, Liaquat university hospital Hyderabad/Jamshoro, from 8 January to 7 July 2020

**Methodology:** There were 222 neonate with jaundice, which were randomly allocated into two groups. One hundred and one neonates were in group "A" who received continuous phototherapy while 111 neonates were treated with intermittent phototherapy called group B. Phototherapy units were identical regarding their manufacture and radiance with 5 blue light tubes at a distance of 15-20 cm above neonate that produced the irradiance of  $20\mu\text{W}/\text{cm}^2/\text{nm}$  at 420-470 nm. Serum bilirubin levels were measured every 12 hourly after starting phototherapy up to 48 hours. SPSS version 22 was used for data analysis.

**Results:** The average age of the neonates was  $2.23\pm 1.45$  days. In this study, the reduction of bilirubin level in both groups after 12, 24, 36, 48 hours of phototherapy and at the time of discharge was not different between groups.

**Conclusion:** Intermittent and continuous phototherapies were found to be equally effective. Because of its additional benefits, intermittent phototherapy can be adopted as a routine procedure instead of continuous phototherapy in neonatal care units, however, it needs to be confirmed by large scale RCTs.

**Keywords:** Intermittent phototherapy; continuous phototherapy; neonatal jaundice; neonatal ward; neonates; physiological jaundice.

## 1. INTRODUCTION

Yellow discoloration of skin and sclera that resulted from accumulation of un-conjugated bilirubin in underlying skin and mucosal membrane usually affects 60% of term and 80% of preterm neonates during the first week of life. It is a commonest clinical condition that require

medical attention to prevent unusual consequences i.e. neurotoxicity [1,2]. In a local report in 2010, about 39.7 babies per 1000 live birth had neonatal jaundice [3]. Normally bilirubin production in neonates is 6-8 mg/kg i.e. two times higher than adults, but due to insufficiency of conjugate enzyme, the level of un-conjugated bilirubin becomes high over certain period of

time, this level declines steadily. High levelsof bilirubin can cause neurotoxicity i.e. kernicterus, cognitive impairment, muscle tone disorder, deafness and sometimes death [4].

As for the prevention of neurotoxicity, there are several methods to treat hyper-bilirubinemia but phototherapy is widely used modality [5].

Usually, continuous phototherapy is routinely used but it causes separation of mother and neonate, interference of breast feeds and increased risk of adverse effects i.e. skin rash, insensible losses, retinal damage, hyperthermia and increased intestinal flow [6].

Beside the potential harms and concerns regarding phototherapy, intermittent approach can produce pleasant and ease, not only for parents and patients but even for hospital staff to accommodate more patients. Despite modification of phototherapy with decrement in light exposure without compromising the efficacy would certainly be advancement over conventional methods [7].

The present study was conducted to evaluate the efficacy of continuous versus intermittent phototherapy in treatment of neonatal hyper-bilirubinemia.

## **2. METHODOLOGY**

### **2.1 Operational Definitions**

#### **2.1.1 Neonatal jaundice**

Neonates that presented after 24 hours of age and <10 days with jaundice but classified as well baby (vitaly stable, feeding well.) with their serum un-conjugated bilirubin level between 12.5mg/dl to 18mg/dl. Jaundice occurring below the age of <24 hours is considered pathological and need hospitalization. Jaundice appears >10 days of life need further workup and hospitalization.

#### **2.1.2 Outcome of phototherapy**

It was measured in term of serum bilirubin level after starting phototherapy at 0 hours, 12, 24, 36, 48 hours and at the time of discharge.

This Randomized clinical trial was done by Non-probability, consecutive sampling technique at Liaquat university hospital Hyderabad/Jamshoro from 8 January to 7 July 2020 (Total 6 month's duration). The sample size was calculated through openepi.com, sample size calculator with statistics of mean serum bilirubin at discharge in

both study groups. Total sample size was 222 with 95% confidence of interval.

Neonate>34- week gestational age, age 24 hours to 10 days with jaundice were included in the study. Sick neonates with presumed sepsis, dysmorphic babies and neonates with co-morbidities (cardiac, skeletal, renal, etc) were excluded from the study. Neonates having the history of kernicterus and exchange transfusion in siblings or having hemolytic jaundice (Hb<10 mg/dl or Retic count >10 mg/dl) were also excluded from the study.

Data was collected through questionnaire- based approach from babies admitted in neonatal ward, fulfilling the inclusion and exclusion criterias. All the information were kept confidential. The neonates were divided into two groups by lottery methods. Group A neonates received Continuous Phototherapy ie. 2 hours on and half an hour off for whole day. Group B was received Intermittent Phototherapy ie. 12 hours on and 12 hours off (breast feeding interval of 20-30 minutes is included in off phototherapy interval.

Phototherapy units were identical regarding manufacture and radiance with 5 blue light tubes at a distance of 15-20 cm above neonate that produced the irradiance of  $20\mu\text{W}/\text{cm}^2/\text{nm}$  at 420-470 nm. Serum bilirubin level was measured every 12 hourly after starting phototherapy up to 48hours. Blood sample was sent to Liaquat university hospital laboratory and analyzed by experienced Lab Technician. Serum bilirubin level was in mg/dl and was noted down on proforma. Routine newborn care, eye pad care, monitoring for sign of dehydration (decrease urinary output, dry oral mucosa, and decreaseskin turgidity) and breast feeding counseling was done in every case as per recommended protocol.

After collection of data the analysis was done by using SPSS software version 23. Mean and standard deviation was calculated for quantitative variables like age, weight and serum bilirubin at start of phototherapy and serum bilirubin up to 48 hours. Qualitative measure like gender was presented as percentage and frequencies. Student t-test was applied to compare the serum bilirubin on different points. Effect modifiers age, weight, gender was controlled through stratification. Post stratification t-test was applied and p value <0.05 was considered significant.

## **3. RESULTS**

There were 222 neonates with jaundice, which were randomly divided into two groups. Most of the neonate's age were between 2 to 3 days in both the groups. The average age of the neonates was  $2.56 \pm 1.77$  days and weight of the neonates was  $2.93 \pm 0.45$  kg. For Mean age, weight and Serum bilirubin at start of phototherapy with respect to both groups (Table 1). There were 130(58.6%) male and 92(41.4%) female.

In this study, the reduction of serial bilirubin levels in both groups 12, 24, 36, 48 hour and at discharge after treatments were not statistically significant. The mean bilirubin after 12, 24, 36 and 48 hours and at discharge in intermittent phototherapy group (group B) was  $14.77 \pm 1.35$ ,  $12.55 \pm 1.39$ ,  $11.15 \pm 1.62$ ,  $9.02 \pm 0.89$  and  $8.19 \pm 1.48$  respectively; while in continuous

phototherapy group the serial levels were  $14.71 \pm 1.37$ ,  $12.52 \pm 1.44$ ,  $11.05 \pm 1.46$ ,  $8.98 \pm 1.03$  and  $8.04 \pm 1.48$  respectively (Table 2).

Stratification analysis was performed to evaluate the effect of age, gender and weight and day of life. There were insignificant difference between the groups (Refer Tables 3-5).

#### 4. DISCUSSION

Jaundice becomes detectable to the naked eye when the total serum bilirubin level exceeds about  $85 \mu\text{mo}$  ( $5\text{mg}/100\text{ml}$ ) and most babies become visibly jaundiced in the first week of life. Approximately 60% of full-term infants and 80% of premature infants develop hyperbilirubinemia during neonatal period. Also 5-10% of them require treatment by phototherapy[8]

**Table 1. Descriptive statistics of characteristics of patients by groups**

Variables	Group A n=111		Group B n=111	
	Mean	Std. Deviation	Mean	Std. Deviation
Age (dayss)	2.56	1.77	2.16	1.27
Weight (kg)	2.93	0.45	2.91	0.50
Serum bilirubin at start of phototherapy	17.22	0.93	17.2	0.84

**Table 2. Comparison of serum bilirubin between groups over period of time**

Serum bilirubin	Group A n=111		Group B n=111		P-Value
	Mean	Std. Deviation	Mean	Std. Deviation	
At start of phototherapy	17.22	0.93	17.22	0.84	0.99
12h	14.71	1.37	14.77	1.35	0.77
24h	12.52	1.44	12.55	1.39	0.89
36h	11.05	1.46	11.15	1.62	0.63
48h	8.98	1.03	9.02	0.89	0.74
At discharge	8.04	1.48	8.19	1.48	0.46

**Table 3. Comparison of serial serum bilirubin levels in babies requiring phototherapy on second day of life**

Serum bilirubin	Group A n=30		Group B n=33		P-Value
	Mean	Std. Deviation	Mean	Std. Deviation	
At start of phototherapy	16.52	1.03	16.80	0.67	0.204
12h	13.28	0.88	13.49	0.62	0.286
24h	11.26	0.84	11.49	0.58	0.200
36h	10.07	0.88	10.35	0.52	0.136
48h	9.04	1.16	9.34	0.41	0.174
At discharge	8.20	1.73	8.59	1.26	0.308

**Table 4. Comparison of serial serum bilirubin levels in babies requiring phototherapy on third day of life**

Serum bilirubin	Group A n=61		Group B n=65		P-Value
	Mean	Std. Deviation	Mean	Std. Deviation	
At start of phototherapy	17.55	0.63	17.41	0.82	0.270
12h	15.20	0.90	15.31	1.11	0.557
24h	12.87	0.94	12.97	1.19	0.592
36h	11.44	0.96	11.67	1.57	0.343
48h	9.07	0.72	9.03	0.91	0.821
At discharge	8.30	1.21	8.29	1.44	0.977

**Table 5. Comparison of serial serum bilirubin levels in babies requiring phototherapy beyond third day of life**

Serum bilirubin	Group A n=20		Group B n=13		P-Value
	Mean	Std. Deviation	Mean	Std. Deviation	
At start of phototherapy	17.26	0.99	17.35	1.03	0.801
12h	15.37	1.64	15.29	1.67	0.902
24h	13.37	2.12	13.11	2.23	0.741
36h	11.32	2.47	10.62	2.57	0.438
48h	8.61	1.49	8.14	1.14	0.346
At discharge	7.01	1.43	6.62	1.25	0.427

In this study the average age of the neonates was  $2.56 \pm 1.77$  days and weight of the neonates was  $2.93 \pm 0.45$  kg. The difference between the mean decreases in serum bilirubin of both groups was statistically not significant. In this study, the reduction of bilirubin levels in both groups 12, 24, 36, 48 hour and at discharge after treatments were not significant. Similarly Chu L, Xue X et.al showed in their systemic review and meta-analysis study that intermittent phototherapy and continuous phototherapy were equally effective in reducing the total serum bilirubin [9]. In another international study by Zhou S et.al there was no significant difference in serum bilirubin levels between continuous and intermittent phototherapy groups at 24, 48 and 72 h after treatment ( $P > 0.050$ ) [10].

A randomized controlled trial was done by Taheritafti R et.al in Iran that showed that, intermittent phototherapy was as effective as continuous phototherapy to treat icteric full-term neonates. The rate of serum bilirubin decline in both groups were similar after 36 hours [11]. In an Indian study by Patil MM et.al the intermittent phototherapy was as efficacious as the continuous phototherapy, the mean age at the time of admission was 76 hours and 77 hours in continuous phototherapy group and intermittent phototherapy groups respectively. Mean total serum bilirubin at 12, 24, 48 hours were  $13.26 \pm 2.4$  mg/dl,  $10.8 \pm 1.72$  mg/dl,  $10.16 \pm 0.95$  mg/dl respectively for continuous and  $12.6 \pm 1.65$  mg/dl,  $10.04 \pm 1.8$  mg/dl,  $9.1 \pm 0.66$  mg/dl respectively for intermittent group ( $p < 0.05$ ) [12]. In another similar Indian by study Suri D et.al the difference between the mean age, mean baseline bilirubin, mean follow-up bilirubin, and the mean decrease in bilirubin for both the groups was statistically not significant [13].

In an international study by Taheritafti R et.al the length of hospital stay was  $2.3 \pm 0.60$  and  $2.46 \pm 0.93$  days in the continuous and intermittent groups, respectively ( $P = 0.516$ ) and there was no

significant differences between them in respect of decrease in serum bilirubin [14].

## 5. CONCLUSION

Our study concluded that Intermittent and continuous phototherapies are found to be equally effective. Additionally it can help in reduction of hospital stay, intermittent phototherapy can be adopted as a routine procedure instead of continuous phototherapy in neonatal care units, and however, it needs to be confirmed by largescale Randomized Control Trials.

## 6. LIMITATIONS OF THIS STUDY

We did this study on healthy neonates with jaundice, so further studies can be conducted on sick neonates with jaundice. We also excluded the extreme premature neonates, so they can also be included in further studies.

## CONSENT

An informed written consent was taken from parents before starting treatment.

## ETHICAL APPROVAL

Ethical approval was taken from the ethical review committee of the university.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

1. Stoicescu M. General Medical Semiology Guide Part I. Academic Press; 2019.
2. Mitra S, Rennie J. Neonatal jaundice: aetiology, diagnosis and treatment. British

- Journal of Hospital Medicine. 2017;78 (12):699-704.
3. Tikmani SS, Warraich HJ, Abbasi F, Rizvi A, Darmstadt GL, Zaidi AK. Incidence of neonatal hyperbilirubinemia: A population-based prospective study in Pakistan. *Tropical Medicine & International Health*. 2010;15(5):502-7.
  4. Tripathi N, Jialal I. Conjugated Hyperbilirubinemia. *Stat Pearls [Internet]*; 2020.
  5. Watchko JF. Neonatal indirect hyperbilirubinemia and kernicterus. In *Avery's Diseases of the Newborn* 2018;1198-1218. Elsevier.
  6. Anand P, Gopalakrishnan S, Sachdeva A, Sahoo T, Sivanandan S. Screening, prevention, and management of neonatal hyperbilirubinemia. *Journal of Neonatology*. 2020; 34(3):153-69.
  7. Raikes AC, Killgore WD. Potential for the development of light therapies in mild traumatic brain injury. *Concussion*. 2018;3(3):CNC57.
  8. Shaw D. Neonatal jaundice. In *x Pharm: The Comprehensive Pharmacology Reference*. 2007;1-4). Elsevier Inc.
  9. Chu L, Xue X, Qiao J. Efficacy of Intermittent Phototherapy versus Continuous Phototherapy for Treatment of Neonatal Hyperbilirubinaemia: A Systematic Review and Meta-analysis. *Journal of Advanced Nursing*. 2021;77 (1):12-22.
  10. Zhou S, Wu X, Ma A, Zhang M, Liu Y. Analysis of therapeutic effect of intermittent and continuous phototherapy on neonatal hemolytic jaundice. *Experimental and therapeutic medicine*. 2019;17(5):4007- 12.
  11. Taheritafti R, Taheritafti M. Comparison of Intermittent and Continuous Phototherapy to Treat Non-hemolytic Moderate Hyperbilirubinemia in Term Infants-A Randomized, Controlled Trial. *Biomedical Journal of Scientific & Technical Research*. 2020;24(2):18065-70.
  12. Patil MM, Gowthami GS, Bijapure HR, Sajjan AK, Kalyanshettar SS, Patil SV. Continuous Vs Intermittent Phototherapy in the Management of Non-Haemolytic Neonatal Hyperbilirubinemia-A Randomised Non-Inferiority Study. *Journal of Nepal Paediatric Society*. 2020;40 (3):185-9.
  13. Suri D, Somasekar R. A comparative study to determine intermittent versus continuous phototherapy for reducing neonatal hyperbilirubinemia at tertiary care hospital in Chennai, Tamil Nadu, India. *Int J Contemp Pediatr*. 2019;6(6):2287-2291
  14. Taheritafti R, Taheritafti M. Intermittent versus continuous phototherapy for the treatment of nonhemolytic moderate hyperbilirubinemia in term infants: a randomized controlled trial. *TUMJ*. 2019; 76(10):686-91.

---

© 2021 Mari et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.