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Comparison of Continuous with Intermittent Phototherapy in The Treatment of Physiological Jaundice in Term Neonates

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ABSTRACT

Background: Neonatal jaundice is a common condition in term neonates, and phototherapy remains the mainstay of treatment. While continuous phototherapy (CPT) is the standard, intermittent phototherapy (IPT) is being explored as a practical alternative. **Objective:** To compare the reduction in serum bilirubin levels and the occurrence of side effects between continuous and intermittent phototherapy in the treatment of neonatal jaundice. **Methods:** A randomized controlled trial was conducted at the Department of Pediatrics, Shalamar Hospital, Lahore, including 148 term neonates aged 1–9 days with physiological jaundice. Participants were randomly assigned into two groups of 74 each: Group A received CPT (2 hours on, 20 minutes off) and Group B received IPT (1 hour on, 30 minutes off). **Results:** Both groups were comparable in baseline demographics and bilirubin levels. After 36 hours, Group A showed a significantly greater mean reduction in serum bilirubin (9.24 ± 0.98 mg/dL) compared to Group B (8.39 ± 0.78 mg/dL) with p = 0.003. The duration of phototherapy was shorter in Group A (38.6 ± 4.2 hours) than in Group B (42.3 ± 5.1 hours, p = 0.02). Minor side effects such as dehydration and hypothermia were slightly more frequent in the CPT group, though not statistically significant. **Conclusion:** It is concluded that continuous phototherapy is more effective than intermittent phototherapy in reducing bilirubin levels in term neonates and achieves the desired effect in a shorter duration. While intermittent phototherapy may be safer and more practical in some settings, continuous phototherapy remains the preferred choice, particularly in neonates with higher bilirubin levels.

INTRODUCTION

Neonatal Jaundice, the yellowish discoloration of skin and sclera is caused by raised serum bilirubin level. It is one of the most common clinical conditions treated by neonatologists daily. About 60% of term and 80% of preterm neonates develop jaundice during the first seven days of life [1]. Raised serum bilirubin level may be toxic to the developing nervous system of neonates and may lead to neurological impairment or permanent neuro-development problems even in term newborns. Different treatment modalities are being used to treat jaundice [2]. Modalities include phototherapy, exchange transfusion, and drugs e.g.; phenobarbitone, metalloporphyrins, IV immunoglobulins, and clofibrate.[2] Among them, phototherapy has been widely adopted initial therapy of choice because of its easy availability, non-invasiveness and high efficiency [3]. Phototherapy was not commonly used until 1968, when Lucy et al used daylight florescent tubes in a clinical trial of treatment of hyperbilirubinemia [4]. Traditional phototherapy units containing fluorescent tubes have standard blue, daylight, and cool white lamps. Those lights that have energy output close to the maximum absorption peak of bilirubin (450 to 460 nm) are the most effective [5].

Phototherapy can be applied both continuously and intermittently. Most of the institutions use it in a continuous way, but the intermittent application is more acceptable, easy, and pleasant to the parents, better for the neonate's feeding, promotes mother-infant bonding, and is also easy for hospital staff. Moreover, some other beneficial procedures like baby massage and Kangaroo Mother Care, could better be applied in intermittent phototherapy [6,7]. In a study, for the group-A (continuous) babies, the mean baseline bilirubin was 17.64mg/dl±1.37 and the mean follow-up biliru bin was 12.86mg/dl±1.53. For the group-B (intermittent) babies, the mean baseline bilirubin was 17.48mg/dl±1.47 and the mean follow-up bilirubin was 12.85mg/dl±1.76. For the group-A (continuous) babies, the mean difference between the baseline and follow-up bilirubin was 4.78mg/dl±1.20 and for the group-B (intermittent) babies, the mean difference was 4.63mg/dl±1.18 (p>0.05) [8]. In

another study, the mean decreases in bili rubin from baseline was 7.43±0.07mg/dl in the continuous group and 7.31±0.48mg/dl in the intermittent group (p>0.05) [9].

But in a study, the mean of total serum bilirubin on admission was 16.01±3.91 mg/dl for the continuous group and 15.21±1.12mg dl for the intermittent group. The TSB mean after 48 hours for continuous phototherapy was 9.26±0.92 mg/dl and 8.9±0.61 mg/dl for the intermittent group, respectively, which was statistically significant (p<0.05) [10]. The present study is being conducted to compare the mean decrease in serum bilirubin using continuous and intermittent phototherapy techniques for neonatal jaundice. This study is aimed to determine the local results of the both intermittent and continuous phototherapy techniques.

Objective

To compare the mean, decrease in serum bilirubin after intermittent versus continuous phototherapy in the treatment of neonatal jaundice

METHODOLOGY

This Randomized controlled trial was conducted at the Department of Pediatrics, Shalamar Hospital, Lahore from 15 April 2024 to 15 October 2024. Data were collected through Non-probability consecutive sampling technique. The sample size was calculated using a 95% confidence level, 80% power of test, and an expected mean reduction in serum bilirubin levels of 9.26 ± 0.92 mg/dL in the continuous phototherapy group versus 8.9 ± 0.61 mg/dL in the intermittent phototherapy group. Each group included 74 neonates.

Inclusion Criteria

- Neonates aged between 1 to 9 days.
- Both male and female neonates.
- Term neonates (gestational age ≥37 weeks).
- Presence of jaundice as per operational definition based on serum bilirubin levels.

Exclusion Criteria

- Neonates with a history of birth asphyxia (APGAR score <3 at 5 minutes).
- Neonates with clinical/laboratory evidence of sepsis (TLC >11,000/mm^3).
- Neonates with jaundice requiring exchange transfusion (serum bilirubin >25 mg/dL after 24 hours of life).
- Hypothermic neonates (body temperature <36°C).

Data Collection Procedure

After obtaining ethical approval from the hospital's ethical review committee and written informed consent from the guardians, eligible neonates were enrolled. Baseline demographic data, including age and gender, were recorded. Diagnosis of jaundice was confirmed through serum bilirubin measurements conducted in the hospital laboratory. Neonates were randomized into two groups using the lottery method. Group A received continuous phototherapy (2 hours on, 20 minutes off), and Group B received intermittent phototherapy (1 hour on, 30 minutes off). The phototherapy timing schedule was strictly monitored by the researcher. Venous blood samples were collected at four time points: before initiating phototherapy (baseline), every 8 hours during therapy, and at the 36th hour. All serum bilirubin measurements were performed in the hospital laboratory, and results were documented in a structured proforma. Strict adherence to the exclusion criteria was ensured to minimize potential confounders and bias.

Data Analysis

Data were analyzed using SPSS version 25.0. Categorical variables, such as gender, were presented as frequencies and percentages. Continuous variables, including age and serum bilirubin levels, were expressed as means with standard deviations (Mean ± SD). An independent sample t-test was used to compare the mean serum bilirubin levels between the two groups at baseline and after 36 hours of treatment. A p-value of ≤0.05 was considered statistically significant. Stratification by gender and baseline bilirubin levels was performed to control for effect modifiers, and post-stratification t-tests were applied accordingly.

RESULTS

Data were collected from 74 patients. The mean age of neonates in Group A (Continuous Phototherapy) was 4.1 ± 1.7 days, while in Group B (Intermittent Phototherapy) it was 4.3 ± 1.5 days (*p = 0.45*). The proportion of male neonates was slightly higher in Group A (56.8%) than in Group B (54.0%), but this difference was not statistically significant (*p = 0.70*). Similarly, the baseline serum bilirubin levels showed no significant variation between the groups (17.5 ± 1.3 mg/dL vs. 17.3 ± 1.1 mg/dL, *p = 0.21*). However, after 36 hours of phototherapy, Group A demonstrated a significantly lower mean serum bilirubin level (8.26 ± 0.92 mg/dL) compared to Group B (8.91 ± 0.61 mg/dL), with a statistically significant difference (*p = 0.005*). The mean reduction in serum bilirubin was also greater in the continuous group (9.24 ± 0.98 mg/dL) than in the intermittent group (8.39 ± 0.78 mg/dL), which was highly significant (*p = 0.003*).

Table 1

Baseline Characteristics of Study Participants

Variable	Group A (Continuous)	Group B (Intermittent)	p-value
Age (days)	4.1 ± 1.7	4.3 ± 1.5	0.45
Male Gender (%)	56.8% (n=42)	54.0% (n=40)	0.70
Baseline Bilirubin (mg/dL)	17.5 ± 1.3	17.3 ± 1.1	0.21
Time Point			
Baseline	17.5 ± 1.3 mg/dL	17.3 ± 1.1 mg/dL	0.21
After 36 Hours	8.26 ± 0.92 mg/dL	8.91 ± 0.61 mg/dL	0.005
Mean Reduction	9.24 ± 0.98 mg/dL	8.39 ± 0.78 mg/dL	0.003

Among males, Group A showed a mean reduction of 9.32 ± 0.95 mg/dL, while Group B had 8.42 ± 0.74 mg/dL (*p = 0.004*). Similarly, in female neonates, Group A had a reduction of 9.12 ± 1.01 mg/dL versus 8.36 ± 0.82 mg/dL in Group B (*p = 0.030*). Additionally, for neonates with baseline bilirubin levels greater than 18 mg/dL, continuous phototherapy was significantly more effective (9.35 ± 0.88 mg/dL) compared to intermittent phototherapy (8.42 ± 0.67 mg/dL), with a p-value of 0.01.

Table 2

Stratified Analysis by Gender and Baseline Bilirubin >18 mg/dL

Stratification Criteria	Group	Mean Reduction (mg/dL)	p-value
Gender	Male	Group A: 9.32 ± 0.95 Group B: 8.42 ± 0.74	0.004
	Female	Group A: 9.12 ± 1.01 Group B: 8.36 ± 0.82	0.030
Baseline Bilirubin >18 mg/dL	Group A Group B	9.35 ± 0.88 8.42 ± 0.67	0.01 —

Neonates in Group A required an average of 38.6 ± 4.2 hours of phototherapy, whereas those in Group B required 42.3 ± 5.1 hours. This difference was statistically significant (*p = 0.02*), indicating that continuous phototherapy achieved effective bilirubin reduction in a shorter period, thereby potentially reducing the length of hospital stay and associated healthcare costs.

Table 3

Duration of Phototherapy Required

Group	Mean Duration of Phototherapy (hours)	Standard Deviation (±SD)	p-value
Group A (Continuous)	38.6	± 4.2	0.02
Group B (Intermittent)	42.3	± 5.1	

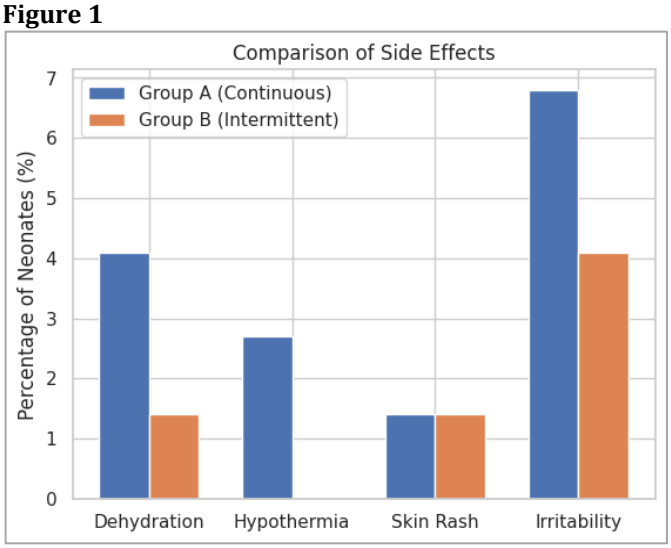
Dehydration occurred in 4.1% of neonates in Group A compared to 1.4% in Group B (*p = 0.31*), while hypothermia was observed in 2.7% of neonates receiving continuous therapy and none in the intermittent group (*p = 0.15*). Skin rash occurred equally in both groups at a rate of 1.4% (*p = 1.00*). Irritability was slightly more frequent in Group A (6.8%) than in Group B (4.1%), though this difference was not statistically significant (*p = 0.47*).

Table 4

Frequency of Observed Side Effects

Side Effect	Group A (Continuous)	Group B (Intermittent)	p-value
Dehydration	3 (4.1%)	1 (1.4%)	0.31
Hypothermia	2 (2.7%)	0 (0%)	0.15
Skin Rash	1 (1.4%)	1 (1.4%)	1.00
Irritability	5 (6.8%)	3 (4.1%)	0.47

Figure 1



DISCUSSION

In this trial, physiological jaundice in term neonates was treated with either continuous phototherapy (CPT) or intermittent phototherapy (IPT) and researchers observed their outcomes and safety. The conclusion revealed that CPT was found to reduce serum bilirubin levels much more over 36 hours than IPT. The group that received postoperative antibiotics continuously had an average bilirubin decrease of 9.24 ± 0.98 mg/dL which was more than the 8.39 ± 0.78 mg/dL decrease seen in the intermittent group (p = 0.003). Similarly to other studies, our data point to the fact that CPT's uninterrupted process may result in faster breakdown of bilirubin. Bhutani and his colleagues found, in a similar tria, that continuous phototherapy is V better than intermittent therapy at removing Bilirubin from the blood, mainly during the first 24 hours of the treatment [11]. The reason for this theory rests in saturation kinetics of bilirubin photoisomerization which explains why more exposure to light increases the likelihood of photoconversion. Yet, even though the difference is real, it may not make a big difference in poorer settings because IPT is useful because of its ease and cost savings [12].

Results from gender-based analysis showed that CPT helped lower bilirubin for both male and female babies, indicating that its benefits can be seen in all patients. Babies with initial bilirubin over 18 mg/dL benefited more from CPT than IPT in terms of lowering the bilirubin levels (p = 0.01). The two treatments were well tolerated when it comes to safety [13]. A number of adverse effects involved dehydration, hypothermia and a skin rash which occurred slightly more often in the CPT group, but the differences didn't show up when tested for statistical significance. In fact, earlier studies by Maisels et al. demonstrate that occasionally CPT may lead to brief side effects tied to being exposed to lights for extended periods, but these are not serious and soon fade [14,15]. Because caregivers are present and can monitor babies close by, IPT might be a reliable alternative to traditional phototherapy. It was significant that the group receiving IPT went through therapy for a mean duration of 42.3 ± 5.1 hours, compared to 38.6 ± 4.2 hours for the CPT group (p = 0.02) [16]. As a result, using intermittent methods could mean putting more effort into dosing in return for higher treatment effectiveness. Even though IPT can help institutions with lots of patients by managing their machines, it leads to patients being hospitalized for a longer period.

CONCLUSION

It is concluded that continuous phototherapy is more effective than intermittent phototherapy in reducing serum bilirubin levels in term neonates with physiological jaundice. The greater mean reduction observed in the continuous phototherapy group indicates a more rapid clearance of bilirubin within the first 36 hours of treatment. Furthermore, continuous therapy required a shorter duration of phototherapy to achieve target bilirubin levels compared to intermittent therapy.

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PROFORMA

Comparison of Continuous with Intermittent Phototherapy in the Treatment of Neonatal Jaundice

Hosp. Reg. no.: _____ Case no: _____ Date: _____

Name: _____

Address: _____

☐ **Group-A** (Continuous photo therapy)

☐ **Group-B** (Intermittent photo therapy)

Gender: Male Female

Serum bilirubin level (mg/dl)	At baseline	After 36 hours	Difference