

Comparison between continuous and intermittent phototherapy in the management of neonatal jaundice

Received: 18/5/2010

Accepted: 23/1/2011

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Abstract

Background and Objectives: Since 1950s, phototherapy had been the treatment of choice for neonatal jaundice. Continuous phototherapy was the pattern used for many years; however intermittent phototherapy was also used with conflicting and controversial results. This work aim is to assess intermittent phototherapy for the treatment of neonatal jaundice in comparison with continuous phototherapy.

Methods: In a prospective clinical study all newborns with neonatal jaundice admitted to neonatology department of Raperin hospital in Arbil, between August 2009 and February 2010, for phototherapy were included in the study. The patients were randomly divided into 2 groups. In the control group continuous phototherapy defined as two hours on and half an hour off was used while in the study group intermittent phototherapy defined as one hour on and one hour off was used. Mean total serum bilirubin level in both continuous and intermittent phototherapy groups were compared after each 12, 24, 36, 48, and 72 hours of commencing phototherapy. The effect of biodemographic characteristics (gender, gestational age, birth weight, age in hours, and bilirubin levels at admission) were also studied.

Results: There was no any significant difference between the two groups regarding mean total serum bilirubin measured at every 12 hours. There was no any significant difference between the 2 groups regarding biodemographic characteristics ($p > 0.05$).

Conclusion: Intermittent phototherapy is as effective as continuous one in the treatment of indirect hyperbilirubinemia in full term infants and in the absence of hemolytic causes.

Key words: Neonatal jaundice; Indirect hyperbilirubinemia; Phototherapy.

Introduction

Since the 1950s, phototherapy has been the therapy of choice for the newborn with indirect hyperbilirubinemia^{1,2}.

The efficiency of phototherapy depends mainly on the intensity and wavelength of the light and also on the proportion of skin area exposed to light³. In nearly all infants phototherapy reduces or blunts the rise of serum bilirubin concentrations, regardless of maturity, presence or absence of hemolysis, or degree of skin pigmentation⁴. Two different mechanisms have been proposed to explain the action of phototherapy in reducing serum bilirubin concentrations in newborn infants, photoisomerization and

photo-oxidation. Compared with photoisomerization pathway, the oxidation mechanism appears to play a very minor role in photocatabolism of unconjugated bilirubin in vivo⁵⁻⁷. Phototherapy appears to be safe in the given decades of experience with its use in western world and lack of reported serious long – term side effects of short-term phototherapy⁸⁻¹⁰, thus far the possible adverse effects associated with phototherapy are: skin rash, increased insensible losses, retinal damage, hyperthermia, and deposition alterations to increased intestinal flow³. Clinical studies comparing intermittent to continuous phototherapy have yielded conflicting results. Several

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studies failed to show effectiveness of the intermittent therapy. These results may have obtained from prolonged light – on and light- off cycles, for example 6- to- 12-hour On- off schedules¹¹

Phototherapy has potential side effects and concern has also been raised on the lack of evidence of safety of phototherapy in the long term run. The modification of phototherapy in which the duration of exposure of newborns to light can be reduced without compromising the efficacy would certainly be advancement over the conventional method. It is in this context that the present study was undertaken.¹⁵

Methods

In a prospective clinical study all newborns with neonatal jaundice admitted to neonatology department of Raperin hospital in Arbil, between August 2009 and February 2010 , for phototherapy were included in the study. Inclusion criteria were: 1) gestational age greater or equal to 37 weeks; 2) non- hemolytic hyperbilirubinemia (negative coomb's test) and no other sign of hemolysis; 3) body weight above 2500 grams; and 4) absence of other concomitant diseases and hyperbilirubinemia neither exceeding the range of exchange transfusion nor requiring high intensity phototherapy⁵ following the adapted AAP Guideline for the management of hyperbilirubinemia in healthy term infants¹⁶

The patients were randomly divided into 2 groups. In the control group continuous phototherapy was used while in the study group intermittent phototherapy was used. Continuous phototherapy group received phototherapy for two hours and then half an hour off. Intermittent phototherapy group received phototherapy for one hour and then one hour off intermittently. Mean total serum bilirubin level in both continuous and intermittent phototherapy groups were compared after each 12, 24, 36, 48, and 72 hours of commencing phototherapy.

The effect of biodemographic characteristics (gender, gestational age, birth weight, age in hours, and bilirubin levels at

admission) were also studied.

Phototherapy was applied using neoBLUE devices; (USA, Natus medical incorporate, neo BLUE) incorporates a special blue LED light source for the treatment of newborn jaundice. The panels were positioned at 30 -40 cm distance from the patients, who were unclothed, but with diapers and concentrating on changing the position of the baby from supine to prone position to expose as much as possible the infant's skin to the impinged radiant of phototherapy. The average light of low intensity radiance was $12 \mu\text{W}/\text{cm}^2 \text{ nm}$ at 450-470 noticing that the manufacturer states that the blue LED'S shouldn't decrease in intensity with age and should not be specially fragile and should also produce less heat because their spectrum is concentrated in the blue region of the light spectrum.

For both groups nursing care was similar, with special emphasis on eye protection and temperature control. Total serum bilirubin was measured every 12 hours after starting phototherapy. For discharge, bilirubin level showing slow a declining trend reaching a value less than or equal to 12 mg\dl.

Data were analyzed using the SPSS version 12 programme. Student's t test was used to compare between mean bilirubin values of the two groups (independent samples t test). A 'P' value of ≤ 0.05 was considered as statistically significant.

Results

Seventy two (72) newborns have fulfilled the inclusion criteria. The mean (\pm SD) total serum bilirubin level on admission was 18.7 ± 1.8 mg\dl in the continuous therapy group and 18.5 ± 1.7 mg\dl in the intermittent group. In comparison of mean total serum bilirubin level in both continuous and intermittent phototherapy after each 12, 24, 36, 48, and 72 hours of commencing phototherapy. There was no any significant difference between the two groups regarding mean total serum bilirubin measured at every 12 hours (p value 0.3, 0.6, 0.6, 0.5, 0.7, respectively). All the infants received

phototherapy for 36, but 22 in continuous therapy and 18 in intermittent therapy group received phototherapy for 48 hours and only 7 in continuous group and 8 in intermittent group needed phototherapy for 72 hours as they are shown in (Table 1).

The biodemographic characteristics of both continuous and intermittent phototherapy groups are shown in (Table 2). There were 39 males (54%) and 33 females (46%). The mean gestational age was 37.9 ± 0.8 weeks in the continuous phototherapy group and 37.9 ± 0.9 weeks in the intermittent phototherapy group. The 511 grams

and 3152 ± 448 grams, respectively. In the intermittent group, the birth weight and the weight on admission was $3428 \pm$ grams and $3127 \pm$ grams, respectively. The age of neonates on admission 82.6 ± 37.7 hours in the continuous group and 78.8 ± 23.8 hours in the intermittent group. The total serum bilirubin level on admission was 18.7 ± 1.8 mg/dl in the continuous therapy group and 18.5 ± 1.7 mg/dl in the intermittent group. There was no any significant difference between the groups for the whole mentioned biodemographic characteristics ($p > 0.05$)

Table 1: Compares of mean total serum bilirubin mg/dl after 12, 24, 36, 48, and 72 hours of both continuous and intermittent phototherapy received groups.

Time of starting phototherapy (hours)	Group	number	Total serum bilirubin mg/dl (mean \pm SD)	t-value	d.f	P-value
12	Continuous	36	14.24(1.73)	1.07	70	0.3*
	Intermittent	36	14.73(2.10)			
24	Continuous	36	13.36(2.20)	0.35	70	0.6*
	intermittent	36	13.57(2.04)			
36	Continuous	22	11.04(1.78)	0.32	38	0.6*
	intermittent	18	10.85(1.84)			
48	Continuous	7	9.78(1.72)	0.57	13	0.5*
	intermittent	8	9.24(1.64)			
72	Continuous	2	8.36(1.63)	0.24	2	0.7*
	intermittent	2	7.94(1.45)			

SD: standerd deviation, d.f: degree of freedom,* not significant

Table 2: Biodemographic characteristics of continuous and intermittent phototherapy scheduled neonates

Characteristics		Continuous phototherapy	Intermittent phototherapy	P value
Sex	Male	20\36	19\36	
	Female	16\36	17\36	
Gestational age(weeks)		37.9±0.8	37.9±0.9	NA
Birth weight(grams)		3367±511	3428±371	0.563
Weight on admission (grams)		3152±448	3127±352	0.793
Age on admission (hours)		82.6±37.7	78.8±23.8	0.610
Bilirubin on admission		18.7±1.8	18.5±1.7	0.629

NA.; Not applicable (same mean)

Discussion

Clinical studies comparing intermittent with continuous phototherapy have shown conflicting results. Because exposure to light hasten excretion of bilirubin, continuous phototherapy should be more effective than intermittent one. However, because the efficiency of phototherapy is mainly related to the initial bilirubin concentration, efficiency will decrease as the bilirubin falls. Rebound into the skin probably takes place when there is an interruption of phototherapy but a question that remains unanswered is whether or not this brief elevation in skin bilirubin might improve efficiency when light therapy is restarted.⁴ In practice, however, short on-off cycles (less than one hour) complicates nursing care and are probably more trouble than may be worth⁶. There is no doubt that phototherapy does not need to be continuous in the majority of circumstances. Phototherapy can and certainly should be intermittent during feeding or brief parental visits. In practice, however, it is not uncommon that the infant does not tolerate phototherapy and parents interrupt it for long period of time⁶⁻⁸. The results of this study showed that intermittent phototherapy defined as one hour on and one

hour off is as effective as continuous phototherapy defined as two hours on and half an hour off, in reducing total serum bilirubin, as with realization that photoisomerization occurs within minutes and bilirubin slowly migrates to the skin over hours, intermittent phototherapy regimens were hypothesized to be effective and where tested⁴, and as photoisomerization of bilirubin occurs primarily in the skin layers and the restoration of the bilirubin pool in the skin takes approximately 1-3 hours. Thus a prolonged on – off schedule may not be as effective as continuous therapy, but an on – off cycle of less than one hour is apparently as effective as continuous treatment.⁴ Our findings come in agreement with other previous studies^{4, 11-13}, as it agrees with studies of Lau and fung in that difference in serum bilirubin kinetics between continuous and intermittent therapy was insignificant¹³, furthermore the study shows that intermittent phototherapy doesn't elongate the duration of therapy as Maurer and Volg stated^{11,12}. Besides its simplicity in application, it is also economically attractive for developing countries where the need is great and resources are scarce. Furthermore, this

regimen is less disruptive to the establishment of infant maternal bonding and breast feeding because the infants are not confined to the incubators during the whole course of treatment¹³.

In our study we excluded infants with very high bilirubin levels because those infants would need intensive phototherapy administered continuously until a satisfactory decline in bilirubin level achieved or exchange blood transfusion is initiated.⁴

Specific recommendations on the initiation of phototherapy are well described. The thresholds at which phototherapy is used are often adjusted according to the gestational age, birth weight and age of the jaundiced babies. On the contrary, criteria for discontinuation of phototherapy are less well described. The American Academy of Pediatrics suggests that phototherapy may be discontinued when the serum level of bilirubin falls below 238-255 $\mu\text{mol/l}$ ¹⁴.

In conclusion this research shows that intermittent phototherapy is as effective as continuous one in the treatment of indirect hyperbilirubinemia in full term infants and in the absence of hemolytic causes.

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