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The effect of white curtains around phototherapy unit on the efficacy of phototherapy in the treatment of neonatal hyperbilirubinemia in Duhok

Dr. Akrem M. Atrushi

Assist Prof, Department of Pediatrics/ College of Medicine/ University of Duhok

ABSTRACT

Background: Phototherapy is the most commonly used therapy in treatment of neonatal hyperbilirubinemia. Factors that increase the reflection of light to the baby's body surface can increase the efficacy of phototherapy in reducing serum bilirubin level. In this study we will use white curtains around phototherapy units and see whether this is effective.

Patients and Methods: A case- control study conducted at Maternity and Obstetric Hospital in Duhok, North of Iraq from January to October 2014. All the neonates admitted to this unit who had significant indirect hyperbilirubinemia were included.The case group received standard phototherapy with white curtain around the incubator thatwas made of white paper which covered three sides while control group was treated by standard phototherapy without a white curtain .The distance between the skin and the lamps was approximately 40 cm. Continuous standard phototherapy units (model DAVID XHZ2-90) with 6 blue lamps (Philips TL 20W/52, Philips Lighting Co., The Netherlands) were used.The total serum bilirubin was measured after 4 hours and then every 12 hours.. Statistical analysis of results was doneby applying SPSS 16.0 to find out the possible significance where P<0.05 is considered significant.

Results: The overall rate of lowering of serum bilirubin in cases with white curtains is 0.85 mg/dl/4 hrs versus0.76 mg/ dl.4 hrs in controls.The rate of TSB lowering incases is significantly higher than in controls in most of weight groups.In the age group of 2, 5 and 6 days the rate was significantly higher in cases than controls. In those with TSB 10.1-15 mg/dl, the rate of TSB lowering was significantly higher in cases than in controls. Also in fullterms the rate of lowering was significantly higher in cases than controls

Conclusion: White curtains around phototherapy unit increases the efficacy of phototherapy in treatment of neonatal hyperbilirubinemia with significant relation to age, weight, maturity and initial serum bilirubin level.

KEYWORDS : : hyperbilrubinemia, phototherapy, curtains

Introduction

A very common cause of hospitalization of neonates is hyperbilirubinemia since around 60% of term neonates and 80% of preterms have it in the first week of life. Phototherapy is the most commonly used therapy in such cases. Irrespective of gestational age, presence of hemolysis or degree of skin pigmentation, phototherapy lowers bilirubin in all newborns.

Although phototherapy has been shown to decrease the likelihood of exchange transfusion, the long term benefits of its use in infants with less severe jaundice are unknown[1,2,3].

Unless the photobilirubin that enters the small bowel is converted rapidly to other water-soluble products or is excreted rapidly, some enterohepatic circulation of bilirubin via reconversion to bilirubin IX-a may occur. Therefore; even with rapid conversion of bilirubin to its products, a rapid decline in serum bilirubin level may not always be seen. A marked advantage of phototherapy is conversion of 10-20% of circulating bilirubin to water-soluble isomers which should be less likely to cross the blood brain barrier [4,5].

Although widely used since 1958, many questions about how to maximize the efficacy of phototherapy remain unanswered.

Three major factors affecting the efficacy of phototherapy include: The wavelength of light used ,lamp energy output and the distance between the lamp and skin surface.

Effective wavelengths range from 420 to 480nm and the best lamps for phototherapy are special blue lamps (F20 T12/BB and TL52 tubes [Philips]).

Lamp energy output to be effective must provide irradiance above the levelsminimally effective in degrading bilirubin but not exceeding levels beyond which no significant increases in response are evident. Ideally in standard phototherapy, energy output is about 6 to 12 μW/cm2/nm while in intensive phototherapy, irradiance is increased to 25 μW/cm2/nm or more.

Standard phototherapy lamps are normally positioned within 40 cm of the patient. Increasing the distance from the lamp to the skin surface of the neonate results in a theoretical diminution of light energy by a factor equal to the square of the increase in the distance. The greater the surface exposed, the greater the effectiveness of phototherapy[6].

Factors that increase the reflection of light to the baby's body surface can increase the efficacy of phototherapy in reducing serum bilirubin level. Several phototherapy units may be used to increase the therapeutic effect[7,8,9,10].

The greater the surface area exposed, the greater the efficacy of phototherapy. For this purpose, white curtains around the phototherapy apparatus which reflect light, can be used. It can increase the efficacy of phototherapy and accelerates neonates' discharge.

A few studies were found in medline that reveal the effect of body weight, gestational age, initial TSB level and the age of baby on the rate of lowering of TSB level with phototherapy. This study will try to find any such correlation in addition to determining the efficacy of phototherapy as treatment of neonatal hyperbilirubinemia to find out whether the use of white curtains around phototherapy units can increase this efficacy.

Subjects and Methods

This case- control study was conducted on neonates with hyperbilirubinemia admitted to neonatal care unit of Maternity and Obstetric Hospital in Duhok, North of Iraq. The study was carried out during 10 months, from January to October 2014. All the neonates admitted to this unit who had significant indirect hyperbilirubinemia were included.

The decision give phototherapy was based on 2004 AAP guidelines for management of hyperbilirubinemia in term and near-term newborns. Newborns were divided into two groups, randomly. The control group was treated by standard phototherapy without a white curtain around the unit and the case group received standard phototherapy with white curtain around the incubator. The curtain was made of white paper which covered three sides except one for observing the newborn or performing procedures. The distance between the skin and the lamps was approximately 40 cm.

All the infants under study had detailed physical examination and necessary lab tests includingblood group of mother and baby, pe-

ripheral blood smear, reticulocyte count, total and differential serum bilirubin,. After starting the treatment, the total serum bilirubin was measured after 4 hours and then every 12 hours .For all thepatients, continuous standard phototherapy units (model DAVID XHZ2-90) with 6 blue lamps (Philips TL 20W/52, Philips Lighting Co., The Netherlands) were used. All units used in the study were serviced before the study. While under phototherapy, neonates were uncovered except for eye pads and diapers.

With 95% of confidence level and 80% power of test, 52 neonates for each group was calculated as the minimum sample size. Statistical analysis of results was done to find out the possible significance of the white covers in increasing the efficacy of phototherapy in relation to age, maturity, weight and initial total serum bilirubin. In all cases, the confidence level of $P<0.05$ was considered as significant between the groups. All of the statistical methods were applied by SPSS 16.0. The study was approved by Ethics Committee of the directorate of Health of Duhok.

Results

The overall rate of lowering of serum bilirubin in cases with white curtains is 0.85 mg/dl/4 hrs while the rate in the controls (without white curtain is 0.76 mg/ dl.4 hrs

According to body weight, the highest rate of serum bilirubin lowering in cases with white curtains is in the weight group of1001-1500 grams while in the group without white curtains it is 2501-3000 grams . The rate is higher in cases than controls in the very low weight groups but the contrary in the rest. The rate of TSB lowering in the presence of white curtains is significantly higher than in the absence of such curtains in most of weight groupsas shown in Table-1-

Table-1- Relation between rate of bilirubin lowering (mg/ dl/4 hr) and body weight

Weight (grams)	cases	No	control	No	P value
= or < 1000	1.01 (0.207)	10	0.38 (0.134)	5	< 0.001
1001-1500	1.1 (0.38)	8	0.68 (0.186)	10	0.007
1501-2000	0.52 (0.22)	16	0.8 (0.278)	16	0.004
2001-2500	0.21 (0.109)	6	0.74 (0.194)	11	< 0.001
2501-3000	1.03 (0.289)	8	1.1 (0.143)	5	0.628
>3000	0.2 (0.129)	4	0.96 (0.439)	5	0.013

The rate of bilirubin lowering varied with the age at which phototherapy started in both cases with white curtains and controls without white curtains so that the highest rate among cases was in the age of 2 days while in controls was the age of 5 days. Only in the age of 2, 5 and 6 days the rate was significantly higher in cases than controlsas shown in Table-2

Table-2-Relation between rate of bilirubinlowering(mg/ dl/4 hr) and age

Age (days)	cases	No	controls	No	P value
1	0.23 (0.114)	6	0.28 (0.007)	3	0.487
2	1.25 (0.15)	12	0.95 (0.06)	9	< 0.001
3	0.67 (0.09)	20	0.65 (0.116)	12	0.589
4	0.88 (0.172)	5	0.92 (0.057)	11	0.487
5	0.99 (0.27)	6	1.55 (0.227)	7	0.002
6	0.42 (0.007)	3	1.16 (0.046)	5	< 0.001

The relation between serum bilirubin level and rate of its lowering by phototherapy in both groups was studied as in Table-3- that shows increase in the rate of lowering by increased serum bilirubin level in both groups except for those with serum bilirubin 10 mg/dl and less. The rate of lowering is significantly higher in the group of TSB 10.1-15 mg/dl with white curtain than in the group without such curtains.

Table-3- The relation between initial serum bilirubin level and the rate of its lowering(mg/dl/4hr)

Initial TSB mg/dl	cases	No	controls	No	P value
= or < 10	0.47 (0.123)	30	0.5 (0.217)	7	0.622
10.1-15	1.18 (0.356)	20	0.55 (0.198)	20	< 0.001
15.1- 20	1.5 (0.07)	2	1.38 (0.59)	15	0.784

Maturity of patients also affected the rate of serum bilirubin lowering in both groups of patients so that prematures showed higher rates of lowering than full terms and rate was higher in those with white curtains than those without. Significant TSB lowering was found in fullterms with white curtains than fullterms without such curtains as shown in Table-4-

maturity	cases	No	controls	No	P value
Fullterm	0.75 (0.222)	22	0.64 (0.072)	25	0.024
preterm	0.84 (0.106)	30	0.82 (0.186)	27	0.615

Discussion

The present results show that using white curtains around the phototherapy unit can accelerate lowering of serum bilirubin in neonates. Other similarstudies show results compatible with the findings of our study.

Djokomulijanto et al evaluated the effect of white curtains around phototherapy unit through studying 97 newborns. The results showed that the rate of bilirubin level decrease in case group (25.24 µmole/l) wassignificantly greater than in control group (24.27µmole/l) ($P<0.001$) [11].

In Hansen' et al study, using white pads around the infant's bed during phototherapy resulted in irradiance increase and thus more effectivephototherapy[12]. Recently it has been shown that the use of LED (Light Emitting Diode) lamps in the phototherapy units are as effective as fluorescent lamps in the treatment of jaundice, while producing less heat[13].

AlsoSalehzadeh et al showed that a mirror behind phototherapy lamps can increase the efficacyof phototherapy without increasing the risk of hyperthermia[14].

The curtains we used did not interfere with feeding or nursing procedure.

As it seems fromthe above studies and our study results, the use of a white curtain around the phototherapy unit can enhance the phototherapy effect in reducing serum bilirubin level through increasing the reflection of the light on the baby's body surface. This can also shorten theduration of phototherapy in neonates without increasing its side effects.

It is also apparent that each of maturity, birth weight, age and initial TSB level affect the efficacy of phototherapy. These most probably relate to the thinness of skin and the amount of bilirubin precipitated in the skin.

We found some limitations in our study despite the impressive results. The sample size is small that may mask otherwise significant results. Another limitationwas lack of a photo radiometer so that we couldn't measure average irradianceon the skin surface of newborns.

Conclusion

The use of white curtains around phototherapy unit increases the efficacy of phototherapy in the treatment of neonatal hyperbilirubinemia.

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