

Role of Short Duration Double Phototherapy in the Treatment of Unconjugated Hyperbilirubinemia

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Author's Contribution

¹Substantial contributions to the conception or design of the work, Drafting the work or revising it critically for important intellectual content, Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved, ²Final approval of the version to be published,

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ABSTRACT

Objective: To determine the role of short duration double phototherapy in the treatment of unconjugated hyperbilirubinemia.

Methodology: This prospective cases series study was conducted at pediatric department of CMH hospital at Malir Karachi. All neonates, who were diagnosed as a case of unconjugated hyperbilirubinemia and admitted to neonatal ward were included. All the cases underwent short duration double phototherapy. Phototherapy side effects, such as skin response and dehydration, were monitored in the babies. After 6 hours of therapy, the serum bilirubin was measured using a bilirubinometer. All those neonates who required exchange transfusion, had a direct bilirubin level of more than 2 mg/dl, were eligible for exchange transfusion during treatment, had hemolytic anaemia, had anaemia (Hb level of less than 10 mg/dl), had birth asphyxia, or were getting inotropic support (IV [intravenous] dobutamine or dopamine) were excluded.

Results: Total 74 neonates were studied, most of the neonates 39(52.7%) presented within 48-72 hours after birth. Majority of the term babies as 59.5% had history of 37-40 weeks of gestation and 28.4% had gestational age history >40 weeks. Out of all, males' babies were 58.1% and female babies were 41.9%. Neonatal bilirubin level was significantly decreased from baseline 18.35+0.97 after 6 hours of double phototherapy as 14.66+1.18 with mean difference of 3.68+1.37 (p-value 0.001).

Conclusion: Short duration double phototherapy found to be the effective, reliable and safe for skin reaction in the treatment of unconjugated hyperbilirubinemia.

Key words: Double phototherapy Hyperbilirubinemia.

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Introduction

Hyperbilirubinemia, often known as jaundice, is a potentially deadly disease in newborns. Prolonged unconjugated hyperbilirubinemia occurs when jaundice lasts longer than two weeks in term babies and three weeks in preterm neonates.¹ The therapy for hyperbilirubinemia among newborns is a topic of great debate and controversy among clinicians due to the jaundice-associated neurotoxicity risk.^{2,3} If the timing of onset, duration, or levels of serum bilirubin deviate considerably from those of physiological jaundice, hyperbilirubinemia is deemed pathological.² High production of bilirubin conjugation, reduced hepatic

absorption of bilirubin conjugation, and reduced bilirubin conjugation are the most common causes of unconjugated hyperbilirubinemia (bound to albumin).^{4,5} Unconjugated hyperbilirubinemia, which is defined by elevated unconjugated bilirubin (UCB) or indirect bilirubin levels in the blood, is the most common cause of jaundice in newborns. A bilirubin-provoked kernicterus or encephalopathy occurs in infants when the elevated level of UCB crosses the blood-brain barrier and deposits in the cerebellum or basal ganglia.⁴ Bilirubin isn't only an irritation particle that has desperate consequences, however bilirubin, such as uric acid is a significant antioxidant circulating in the neonatal biologic system.^{6,7}

Nonetheless, levels of raised bilirubin can be toxic for the development of central nervous system and neurological and behavior impairment, even in term neonates. Around 5-10% of neonates who develop jaundice require treatment for hyperbilirubinemia. Newborn jaundice can be caused by a variety of factors, including gestational age, birth weight, maternal infection, premature rupture of membranes, or other illness during pregnancy, resulting in a variety of types.⁶ In most situations, jaundice is a harmless disease that does not require treatment. However, 10-15% of jaundiced babies have clinically severe jaundice, necessitating phototherapy or other treatment alternatives.^{8,9} The most common treatment for reducing bilirubin levels in newborns is phototherapy. Double phototherapy implies utilizing 2 light sources (boards) as either 2 horizontal panels, reflecting objects or fiber-optic covers (which are set below the child) and between these 2 sidelong panel procedures is much of the time used. Double phototherapy means using 2 light sources (panels) in the form of either 2 lateral panels, reflecting objects, or fiber-optic blankets (which are placed below the baby). Among them, 2 lateral panel technique is frequently used.¹⁰ Phototherapy lights should be turned off during the blood tests drawn for serum bilirubin diagnosis, since the lights will follow up on the bilirubin shades in the blood test, causing the bilirubin level to decrease.¹¹ The use of two types of phototherapies may improve the treatment's efficacy. The effectiveness of phototherapy is proportional to the amount of surface exposed to it:¹² Phototherapy with two surfaces can possibly be more successful than phototherapy with one surface.¹²

The goal of this study intended to see how effective short-term double phototherapy is for treating unconjugated hyperbilirubinemia.

Methodology

This prospective cases series study has been undertaken at pediatric department, CMH hospital, Malir, Karachi. A total of 74 patients sample size was done by using rao-soft sample size calculating online software by using the proportion of (jaundice among neonates)⁶ with 95% confidential level and 6% margin of error. All neonates, who were diagnosed as a case of unconjugated hyperbilirubinemia and admitted to neonatal ward were included. All those neonates who required exchange transfusion, had a direct bilirubin level of more than 2

mg/dl, were eligible for exchange transfusion during treatment, had hemolytic anaemia, had anaemia (Hb level of less than 10 mg/dl), had birth asphyxia, or were getting inotropic support (IV [intravenous] dobutamine or dopamine) were excluded. Unconjugated hyperbilirubinemia was measured in terms of level of total serum bilirubin that needed phototherapy based on the baby's age and a direct bilirubin proportion of less than 15% of total bilirubin. Low hemoglobin levels and an elevated reticulocyte count were both indicators of hemolysis, besides hemolysis findings by peripheral smears. Clinical examination was done and detailed history was taken from each study subject after informed consent. All of the patients received double phototherapy for a short period. Phototherapy side effects, such as dehydration and skin reaction, were monitored in the babies. The bilirubin meter was used to assess the serum bilirubin 6 hours per day till the completion of the therapy. All of the information was gathered using a research proforma. SPSS version 20 was used to analyse the data. Frequency and percentage were computed for categorical variables. Mean and standard deviation were computed for numerical variables. T-test was applied and a p-value <0.05 was considered as significant.

Results

Total 74 neonates were studied, most of the neonates 39(52.7%) presented within 48-72 hours after birth, followed by 35.1% presented within 72-96 hours after birth and 12.2% were admitted after >48 hours after birth. The majority of the term babies as 59.5% had a history of 37-40 weeks of gestation and 28.4% had gestational age history >40 weeks, while 12.2% of births were done before 37 weeks of gestation. Out of all males babies were 58.1% and female babies were 41.9% and the possible risk factors are presented in table I

Neonatal bilirubin level was significantly decreased from baseline 18.35 ± 0.97 after 6 hours of double phototherapy as 14.66 ± 1.18 with mean difference of 3.68 ± 1.37 (p-value 0.001). Table II

Discussion

In low-resource countries, neonatal jaundice is among the most prevalent reasons for hospitalization. Because traditional phototherapy necessitates frequent bulb replacements, therefore treatment is often insufficient. In this study, most of the neonates presented within 48-72

Table I: Descriptive statistics of demographic variables (n=74)

Variables	Statistics
Age	>48 hour 09(12.2%)
	48-72 hours 39(52.7%)
	72-96 hours 26(35.1%)
Gestational age	<37 weeks 09(12.2%)
	37-40 weeks 44(59.5%)
	>40 weeks 21(28.4%)
Gender	Males 43(58.1%)
	Females 31(41.9%)
Risk factors	RH incompatibility 04(5.4%)
	ABO incompatibility 06(8.1%)
	Exaggerated physiological 50(67.6%)
	Polycythemia 11(14.9%)
	G6 PD deficiency 03(04.1%)

Table II: Unconjugated bilirubin level after 6 hours of double phototherapy with mean difference (n=74)

Statistics	Initial bilirubin	Bilirubin after 6 hrs	Mean difference	p-value
Mean	18.35	14.66	3.68	
Median	18.90	14.90	3.70	0.001
Std. Deviation	0.97	1.81	1.37	
Minimum	16.00	9.90	1.10	
Maximum	19.60	17.25	6.30	

hours after birth, followed by 35.1% presented within 72-96 hours after birth, and 12.2% were admitted after >48 hours after birth. The majority of the term babies as 59.5% had a history of 37-40 weeks of gestation and 28.4% had gestational age history >40 weeks, while 12.2% births were done before 37 weeks of gestation.

Of all the male babies, 58.1% were born, and 41.9% were female babies. Similarly, Milyana NS et al² reported that out of total of 30 cases that underwent double phototherapy, 16 were males and 14 were females. In another study of Naderi S et al¹³ males and females term, neonates were 21 (52%) and 19 (48%) respectively. The likelihood of High total serum bilirubin (TSB) increases with non-Caucasian race, as and the male gender and similarly does the cephalohematoma evidence.^{14,15}

In this study, neonatal bilirubin levels were significantly reduced from baseline 18.35+0.97 to 14.66+1.18 after 6 hours of double phototherapy, a mean difference of 3.68+1.37 (p-value 0.001). Consistently, Milyana NS et al² compared the efficacy of double and single phototherapy and elevated spectral irradiance for lowering serum bilirubin concentrations among neonates

in case of indirect hyperbilirubinemia, and it was found that in jaundiced babies, double phototherapy remained more successful than single phototherapy at lowering bilirubin levels. However, Arnolda G et al¹⁶ reported that when many possible confounders are taken into account, double phototherapy can significantly speed up TSB reduction while also reducing treatment time and stay length in NCU. Naderi S et al¹⁰ also contrasted the indirect hyperbilirubinemia with hospital stay length and efficacy of triple and double phototherapy among newborns and it was found that triple phototherapy did not lower total serum bilirubin levels or failed to shorten hospitalization stay much faster than the double phototherapy. Stokowski LA et al¹¹ in their study stated that the most common significant decreases in the level of bilirubin happen during the first 4 to 6 hours after starting the phototherapy.

Conventional (single) phototherapy may reduce the level of serum bilirubin by around 22% during the initial 24 hours of the management, while double phototherapy can decrease the as much as 29% during the initial twenty-four hours,^{11,17} and intensive phototherapy may reduce bilirubin levels by up to 5 mg/dL/h in neonates with rapidly increasing bilirubin levels; stabilising bilirubin levels or slowing its rate of increase should be considered a valid measure of successful therapy.^{11,18} In few other previous studies found comparable findings as Sarici et al¹⁹ reported that the effectiveness of the double phototherapy by utilizing the standard phototherapy unit consisting of 5 particular blue lamps collectively with the fiberoptic phototherapy pad beneath the bodies of the neonates and the decreasing rate of the bilirubin was higher than that in the single phototherapy possibly may due to the greater irradiance of the authors' unit of phototherapy.

Aithumanon and Visutiratmanee et al²⁰ demonstrated that double surface phototherapy reduced bilirubin levels by 3.4+2.0 mg/dl on the first day, which was greater than single conventional phototherapy. No more recent studies have been found in the literature and this study also a small sample size and single center study. Although further large sample size and multicenter studies should be done on this subject.

Conclusion

Short duration double phototherapy was found to be effective, reliable, and non-invasive. It is also safe for babies for their skin safety due shortage of time. Further large-scale studies are required on this subject.

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