Declining pattern of bilirubin in the first and second six hours of intensive versus double phototherapy in neonatal jaundice

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Abstract

Background: Although phototherapy has been used in clinical practice for 50 years, there is still much debate about how the most efficacious phototherapy application can be provided.

Objective: This study aimed to define the most effective hours of declining serum bilirubin in two types of phototherapy (double versus intensive phototherapy) in treatment of severe hyperbilirubinemia of neonates.

Materials and methods: A total of 100 healthy full-term neonates with no hemolytic hyperbilirubinemia (total serum bilirubin between 20 to 25 mg/dl) were compared in a historically controlled study. The first group received double phototherapy (DP) (8 lamps) and the second group received intensive phototherapy (IP) (12 lamps).

Results: The mean serum bilirubin decline in IP group was statistically significant in comparison with DP group in the first 6 hours of phototherapy (4.65 ± 2.02 mg/dl versus 3.59 ± 1.86 mg/dl, P=0.008). The mean serum bilirubin decline was not statistically significant (P=0.277) in the second 6 hours of phototherapy between two groups.

Conclusion: This study showed IP declined bilirubin level more than DP statistically in the first 6 hours of phototherapy. As there was no difference between DP and IP in the rate of bilirubin decline in the second 6 hours of phototherapy, DP can be used instead of IP if total bilirubin is high but under exchange transfusion level in the second 6 hours of phototherapy.

Background

Neonatal hyperbilirubinemia is one of the most common diseases worldwide and can be treated effectively by phototherapy [1,2]. Although it is usually benign in term and preterm neonates [3], severe hyperbilirubinemia is a medical emergency because bilirubin is a neurotoxic substance [4] that can cause neurologic defects [5]. Management of hyperbilirubinemia in neonates is still a critical issue. For several decades phototherapy has been known as a standard therapy for neonatal hyperbilirubinemia [6]. Some variables like wave length of light, energy output or irradiance, exposed surface area to the light, the distance between the body and the source of radiation may influence the efficacy of phototherapy [7]. Accordingly, several studies have been done to compare the efficacy of different modes of phototherapy [9].

The aim of this study was to compare the declining pattern of serum bilirubin in the first 6 hours and 12 hours after Intensive phototherapy (IP) versus double phototherapy (DP) in severe neonatal hyperbilirubinemia.

Materials and methods

This is a historically controlled study conducted in Neonatal ward of Bahrami Children Hospital (Tehran University of Medical Sciences), Tehran, Iran, between January 2012 to January 2013. The study group consisted of neonates admitted to our neonatal ward to be treated with IP during the study period. These neonates were compared with a historical control group who had been admitted between January 2011 to January 2012 and treated with conventional DP.

Infants who met the following inclusion criteria were assessed: healthy term newborns with birth weight equal to or more than 2500 gr, normal hemoglobin and hematocrit, normal reticulocyte count and total serum bilirubin level of 20-25 mg/dl. Exclusion criteria included any congenital malformations or infections, evidence of hemolysis or blood group incompatibility, history of exchange transfusion and presence of acidosis, hypoglycemia, hypoalbuminemia, sepsis and
Group in comparison with double group in the first 6 hours of phototherapy, the decline rate of serum bilirubin in the second 6 hours of phototherapy had no significant difference between the two groups (P = 0.27).

Discussion

In this study we compared the efficacy of IP and DP for declining rate of serum bilirubin in 6 and 12 hours of therapy. There was a significant difference in the speed of bilirubin decline rate between the two groups. The patients who received IP showed more decline rate of serum bilirubin after 6 hours in comparison with DP. The decline rate of serum bilirubin was statistically significant in the first 6 hours in IP group (P = 0.008) versus the second 6 hours (P = 0.277) in comparison with DP group.

Naderi’s study [10] compared the benefits, complications and length of hospitalization between double and triple phototherapy in term newborns with indirect hyperbilirubinemia. He showed triple phototherapy had no particular benefit to double phototherapy and had no significant difference in overall decline rate of serum bilirubin. In this study the third phototherapy set was placed in the line with width of the bassinette, and a 35 cm distance from the bed that obviously decreased the efficacy of phototherapy (2009).

Zahed Pasha [11] compared the efficacy of single, double and intensive phototherapy for declining of serum bilirubin. In spite of significant decrease of serum bilirubin in 3 types of phototherapy, intensive phototherapy was more effective than single and safer than double phototherapy in reduction of bilirubin. The change of body temperature as a complication phototherapy was significant in DP but not in IP (2006). His findings confirmed our results. [12,13] studies showed that double phototherapy reduced serum bilirubin concentration more rapidly than single. Nuntnarumit and Naka confirmed the same results (2002) [4].

Several studies like [14-16] studies have proven the rapid decline of bilirubin by different kinds of IP. In our study the overall bilirubin decline rate of 0.65 ± 0.25 mg/dl/h (2.74 ± 1.03 %/h) in DP was less than the overall decline rate of 0.78 ± 0.18 mg/dl/h (3.44 ± 0.78 %/h) in IP with p = 0.08 versus p < 0.01 (Table 2).

In spite of significant decline rate of serum bilirubin in intensive

| Variable                          | Intensive phototherapy | Double phototherapy (n=50) | P     |
|-----------------------------------|------------------------|----------------------------|-------|
| Mean serum bilirubin (mg/dl)      | 22.67 ± 1.91           | 23.63 ± 2.1                | 0.09  |
| Decrease of serum bilirubin after the first 6 hours (mg/dl) | 4.65 ± 2.02 | 3.59 ± 1.86 | 0.008 |
| Decrease of serum bilirubin after the second 6 hours (mg/dl) | 4.47 ± 1.86 | 4.32 ± 1.79 | 0.277 |
| Decrease of serum bilirubin after 12 hours (mg/dl) | 9.36 ± 2.22 | 7.86 ± 3.02 | 0.008 |
| Overall decline rate of bilirubin (mg/dl/h) | 0.7 ± 0.18 | 0.65 ± 0.25 | 0.008 |
| Overall decline rate of bilirubin (percent/h) | 3.44 ± 0.78 | 2.74 ± 1.03 | <0.001 |

Table 2. The response of groups to phototherapy (Value are given as mean ± SD).
There are different overall decline rate of bilirubin (mg/dl/h and %/h) between DP and IP in various studies because of different kinds of DP and IP devices, phototherapy lamps and distances from the patients.

Our results show that IP (12 phototherapy lamps divided equally above and below the baby) is more effective than DP (8 phototherapy lamps all above the baby) for declining of serum bilirubin level especially in the first 6 hours of phototherapy in apposite to the second 6 hours of phototherapy.

Conclusion

This study showed IP declined bilirubin level more than DP statistically in the first 6 hours of phototherapy. As there was no difference between DP and IP in the decline rate of bilirubin in the second 6 hours of phototherapy, DP can be used instead of IP if total bilirubin is high but under exchange transfusion level in the second 6 hours of phototherapy.

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Competing interest

The authors declare that they have no competing interests.

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