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Supine versus turning position on bilirubin level during phototherapy in healthy term jaundiced neonates

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Phototherapy is by far the most widely used treatment for hyperbilirubinemia and it is both safe and effective. Even though phototherapy has been used on millions of infants for more than 30 years,[1] specific questions regarding methods of optimizing efficacy remain unanswered. Changes of position are believed to increase the efficacy of phototherapy[2,3] and this practice was routinely used in approximately all neonatal departments in our country. The aim of this study was to determine the effect of routine turning versus supine position on the total serum bilirubin (TSB) concentration during phototherapy.

In a randomized clinical trial 50 term jaundiced neonates who were admitted to the neonatal ward of Emam-Reza Hospital, a University Hospital affiliated to Mashhad University of Medical Sciences, Iran were elected. All babies were healthy, exclusively breastfeeding, ≥49 hours postnatal age, birth weight more than 2500 grams, delivered at 38th - 41th weeks of gestational age after an uncomplicated pregnancy. They had indirect hyperbilirubinemia with total TSB ≥15 mg/dl in 49 - 72-hour-old jaundiced infant and equal or more than 17 mg/dl in ≥72 hour-old ones (same as practice parameter of American Academy of Pediatrics [AAP])[4] Infant with hemolytic disease, infection, congenital anomaly, closed hemorrhage (cephalhematoma), and metabolic disease were excluded. After parental permission, 25 babies (turning group) were randomly changed from supine to prone position every 150 minutes according to Shinwell study[5] followed by a break of 30 minutes for feeding and routine nursing care. The supine group (n=25) were kept in supine position during the entire study period. Total and direct TBS level were measured at the beginning, 12, 24 and 48 hours after phototherapy. Measurement of bilirubin and phototherapy were continued until the TSB declined to less than 14 mg/dl. All infants in this study were examined 2 days after discharge in the outpatient clinic for evaluation of recurrent jaundice. Laboratory investigations included of complete blood count, blood group typing of babies and their mothers, direct and indirect Coombs tests, reticulocyte count, TSB level (total and direct), blood peripheral smear and erythrocyte G6PD level. The clinical examination, gestational age, birth weight, gender, age, weight at admission, serial TSB and direct bilirubin were recorded. Serum bilirubin was measured by using a Unistat® Bilirubinometer (Reichert-Jung, Germany). The determination of direct bilirubin was made by colorimetric method of Lathe and Ruthven. Each phototherapy unit contain 4 blue fluorescent tubes (TL20W/52) at a wavelength of 420 - 480 nm positioned 20 cm above the infant's mattress. During phototherapy, the infants were naked except for a diaper and eye cover. Baby temperature was measured every 4 hours. The obtained data were analyzed with Statistical Package for Social Sciences. Numerical variables were compared between the 2 groups using the independent students, t-test, chi-square test and Mann-Whitney. *P*-value of less than 0.05 was considered statistically significant. There were no statistically significant difference between the 2 groups in gender (p=0.76, chi-square test), postnatal age (p=0.93, t-test), weight at admission (p=0.85, t-test) and duration of hospitalization (p=0.94, t-test). In addition, there were no significant differences between the 2 groups regarding reticulocyte count (p=0.49) and hematocrit (p=0.99). Therefore, 2 groups were comparable. The mean TSB in 2 groups at enrollment (p=0.93) after

12 hours (p=0.93), 24 hours (p=0.58), and 48 hours (p=0.93) of phototherapy was not significant. After phototherapy, there was a significant drop in TSB in both groups, **Table 1**. During hospitalization and 2 days after discharge in outpatient clinic, no side effects were observed.

The present study showed that turning of term infants with hyperbilirubinemia does not increase the efficacy of phototherapy. Vogl[6] has suggested that turning the infant during phototherapy cause large drop in total TSB concentration. He believed that the efficacy of phototherapy is directly correlated with the concentration of bilirubin in the skin. Thus, when the skin is blanched, phototherapy would be expected to be ineffective.[5] Yamauchi et al[7] compared turning every 6 hours with no turning in 44 full term healthy newborns with hyperbilirubinemia, demonstrating that total decrease of skin bilirubin on the surface of the body is not affected by the baby's position during phototherapy. It is known that the primary action site of phototherapy is the skin and subcutaneous capillary bed in 2 mm of surface area of skin.[6,7] In addition, bilirubin molecules leave the intravascular space by diffusion along a concentration gradient, which is maximal close to blood vessels.[5] During phototherapy bilirubin molecules in the extra vascular space act as a filter that absorbs the photons and prevents their reaction with bilirubin in the vascular space. Water soluble isomers, which are produced, diffuse back into circulation and subsequently excreted in the bile.[5,8] These isomers presumably are formed rapidly in the skin, subcutaneous tissue and in capillaries.[3] Being more polar all of isomers partition into the plasma, continuously shifting the equilibrium to promote more isomer formation.[7] After blanching of the skin photons can reach the capillaries in the dermis and react directly with intravascular bilirubin. The time required for diffusion of bilirubin into and out of the extra vascular space has been estimated as 1-3 hours.[3] Therefore, by saving the diffusion time, intravascular photoisomerization may be more efficient. Increased amount of blood available for interaction with photons of light due to hyperemic effect of phototherapy may also enhance intravascular photoisomerization. Thus, it is reasonable to assume that bilirubin can also undergo photoisomerization when bound to albumin in the blood.

The result of our study, comparing a turning group, which position changes occurred every 150 minutes during phototherapy and a supine position continuously, demonstrated that a change in position every 150 minutes was not effective to decline total TSB. We do not exclude the use of turning position, even if it is as effective as the supine position but we recommend its use be limited in healthy full-term infants with hyperbilirubinemia who have no sign of hemolysis.

Table 1 - Changes in serum bilirubin level during phototherapy.

Total serum bilirubin	**Supine mg/dl m mean ± SD**	**Turned mg/dl m mean ± SD**	***p*-value**
Bilirubin at start of phototherapy	18.8 ± 2.5	18.8 ± 2.1	0.93*
Bilirubin at 12 hours after phototherapy	14.8 ± 2.5	15.2 ± 1.8	0.58*
Bilirubin at 24 hours after phototherapy	12.2 ± 2.7	12.1 ± 2.0	0.74*
Bilirubin at 48 hours after phototherapy	9.5 ± 2.4	9.6 ± 2.1	0.93**

* - t-test
** - Mann-Whitney test

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