



ORIGINAL ARTICLE

The Effect of Home Phototherapy in Jaundice and Bilirubin Levels of Neonates in Urmia City

Milad Ebrahimi Saeid¹, Kamran Dehghan^{*1}, Zahra Fakoor²

¹Associate Professor of Neonatal-Perinatal Medicine, Department of Pediatric Disease, School of Medicine Shahid Motahari Hospital, Urmia University of Medical Sciences, Urmia, Iran

²Resident of General Surgery, School of Medicine, Urmia University of Medical Sciences, Urmia, Iran

(Received: 12 August 2021

Accepted: 8 November 2021)

KEYWORDS

Home phototherapy;
Jaundice;
Bilirubin;
Neonates

ABSTRACT: Neonatal jaundice is one of the most common diseases in neonatal medicine. Phototherapy is a safe and secure method and is one of the most common treatments of indirect hyperbilirubinemia. This study aimed to evaluate the effect of home phototherapy in neonatal hyperbilirubinemia in Urmia. The present study is a cross-sectional study by the Cohort method. Two hundred three full-term infants older than 24 hours, who were referred to phototherapy for home phototherapy for two months, were selected as the study population. Neonatal serum bilirubin levels in both groups were measured at the beginning and 24 hours after phototherapy. The collected data were analyzed by using SPSS-20. In this study, the mean neonatal bilirubin level before phototherapy was 14.33 ± 2.41 mg dl⁻¹ before and 8.11 ± 2.29 mg dl⁻¹ after phototherapy. The reduction rate of bilirubin after home phototherapy was 6.6 mg dl⁻¹ per day and these differences were statistically significant. During phototherapy at home, phototherapy was successful in 96.6% of the neonates recovered, and only seven neonates (3.4%) had complications. Due to the lower prevalence of complications and low duration of treatment, it can be concluded that home phototherapy can be a good alternative for the treatment of neonatal jaundice. Therefore, this method is recommended for the treatment of neonatal jaundice through proper phototherapy training at home.

INTRODUCTION

One of the most common diseases in neonatal medicine is jaundice, which is observed in about 60% of full-term neonates and 80% of preterm neonates in the first week after birth [1]. One of the most common methods of reducing indirect hyperbilirubinemia is phototherapy. In this method, bilirubin molecules absorbing light energy are converted into photo and structural isomers and readily excreted in the urine and the liver [2]. The most common therapy used to treat neonatal jaundice and prevent its complications is phototherapy. Phototherapy is a safe and

healthy method that has been tried for decades to treat neonatal jaundice. Photo isomerization of insoluble indirect bilirubin on the skin surface and its conversion to polar and soluble form is the most important mechanism of excretion of bilirubin through phototherapy and is responsible for 80% of the effectiveness of this treatment [3]. Phototherapy is known as a non-aggressive and effective treatment method in treating neonatal jaundice, and it is widely used today [4]. Currently, in our country's medical system, phototherapy is usually started after the baby is

*Corresponding author: dehghan.k@umsu.ac.ir (K. Dehghan)
DOI: 10.22034/jchr.2021.1937705.1381

hospitalized. Unfortunately, the infant's hospitalization in the first days of birth is accompanied by nosocomial infections, separation of mother from baby, transportation problems between hospital and home, occupation of hospital beds, and additional costs. The results of various studies have shown that home phototherapy is safer and more effective than long-term hospitalization for mature and healthy infants [5, 6]. An essential motivating factor in performing phototherapy at home is the non-separation of a mother from her child [7].

Doing phototherapy at home requires the knowledge and desire of parents. According to studies, the rate of bilirubin reduction in infants who received phototherapy at home is the same as those who receive phototherapy in the hospital, as well as the cost of phototherapy at home is much less than phototherapy in the hospital. Phototherapy at home is a viable, safe and effective alternative to phototherapy in the hospital [8].

Today, home phototherapy is very popular due to the importance of preventing the separation of mother and baby and continuing home care [9]. On the other hand, home phototherapy can lead to complications if the standards are not followed and not be under the supervision of qualified doctors and nurses. Rogerson et al. believe that phototherapy can be quickly done at home. Still, it can be better if pediatricians and nurses provide primary care rather than other groups, for any reason, sometimes without the necessary expertise, provide treatment equipment to prepare phototherapy at home [10].

There are various reports that home phototherapy is safer and more effective than long-term hospitalization for healthy full-term infants [10]. Due to differences in the results of studies in home phototherapy, National Institute for Child Health and Human Development (NICHD) began a human development study that looked forward to neonatal hyperbilirubinism from 1974 to 1976 and answered ambiguities and questions about home phototherapy [11]. This study and several studies on full-term infants who received phototherapy at home showed that home phototherapy is a safer, more effective, and more convenient method than in-hospital phototherapy has no severe side effects and significantly saves money per

patient compared to hospitalization. Successful treatment of neonatal jaundice at home using phototherapy has been reported to be successful in various parts of the world, including Scotland and Australia, and Iran [12]. According to studies conducted in Iran, if phototherapy is performed at home under the supervision of experienced medical and nursing staff, in 92.6% of cases, it can be a suitable and effective alternative method for treating healthy infants with indirect jaundice in the hospital [13].

The main feature of home phototherapy is the non-separation of mother and baby. The health of infants and children in adulthood is essential. If parents are trained in-home phototherapy under the supervision of trained nurses, home phototherapy can be an excellent alternative to in-hospital phototherapy interventions [12]. Therefore, the family can act to prevent the behavioral problems of these children and adolescents and increase their social abilities [14]. According to available data, phototherapy at home is not officially performed in medical centers, and the health system still does not trust this method.

MATERIALS AND METHODS

This study is a cross-sectional study by the Cohort method. Two hundred three full-term infants older than 24 hours were referred to home phototherapy for two months as a census to receive a phototherapy device. They were selected as the study population. Two hundred three term infants older than 24 hours were included in this study. Infants with indirect hyperbilirubinemia with a total bilirubin level of 13-17 mmol/L weighed 2500-4000 grams and did not have any risk included in our study. After reviewing and studying, eligible infants were randomly assigned to research and underwent phototherapy at home. White fluorescent lamps were placed over the baby's head with full coverage of the eyes and genitalia for phototherapy. The required amount of phototherapy was determined based on the severity of jaundice for mild (Single), moderate (Double), and severe (Intensive) hyperbilirubinemia, respectively. Sampling for bilirubin was performed again 24 hours after the start of phototherapy. Newborns were examined daily for

complications (diarrhea, rash, dehydration). In this study, intensive phototherapy is a product of Tucson Company, models 225 and 16 lamps, which could be evaluated using the timer of the device used to assess the duration of phototherapy. Phototherapy was discontinued only for breastfeeding and changing diapers. The power output of the devices was measured with a photometer made by David company, which averaged ten microwatts percent [7].

After completing the sample size, information was collected through a checklist, including gender, the mother’s education, mode of delivery, the history of hospitalization of the infant, type of feeding, history of jaundice in previous children.

Inclusion criteria

- 1- Gestational age infants over 37 weeks
- 2- Infants with 2500-4000grams
- 3- Infants with total bilirubin level of 13-17 m m⁻¹
- 4- Age more than 24 hours

Exclusion criteria

- 1- Premature infants (weight under 2500 grams or fetal age under 37 weeks)
- 2- Infants who had to receive serum
- 3- Infants who had congenital anomalies

- 4- Newborns with a history of phototherapy or blood transfusions
- 5- Infants with blood disorders, hemolysis and infection

Data analysis

Data were collected into SPSS-20 software and analyzed by independent t-test and Pearson and Spearman correlation. Satisfaction and assurance of the confidentiality of infants’ information were among the ethical considerations of the research.

RESULTS

In this study, 203 neonates with jaundice referred to phototherapy centers at home (private sector who rent a phototherapy device) were analyzed during two months of the study. The frequency distribution of demographic information showed that 49.3% of infants were boys and 50.7% were girls. The education level of the majority of mothers (57.1%) was high school. Also, most mothers (73.9%) had a natural vaginal delivery. On the other hand, most infants (86.7%) were breastfed, and most families had no history of jaundice in previous children. Investigation of the frequency distribution of how infants were referred for home phototherapy showed that a pediatrician referred 72.4% of infants for home phototherapy, and 26.6% were referred by a subspecialist (Table 1).

Table 1. Demographic characteristics of neonates studied at home phototherapy

Variable		Abundance	Percent
Gender	Boy	100	49.3%
	Girl	103	50.7%
Mother’s Education	illiterate	3	1.5%
	High school	116	57.1%
	University	84	41.4%
Mode of Delivery	Normal vaginal	53	26.1%
	Cesarean section	150	73.9%
Birth	Term	150	73.9%
	Pre-term	53	26.1%
Type of Feeding	Breast milk	176	86.7%
	Formula	5	2.5%
	Formula / breast milk	22	10.8%
The History of Hospitalization	Yes	12	5.9%
	No	191	94.1%
History of Jaundice in Previous Children	Yes	47	23.2%
	No	156	76.8%

Investigation of the frequency distribution of the final outcome of home phototherapy for infants with jaundice referred to home phototherapy centers shows that 96.6% of infants recovered and only 3.4% did not recover. Also, as it

turned out, hyperthermia in 2 infants, dehydration in one infant, restlessness in 3 infants, and improper technique in one infant were seen as complications of phototherapy at home (Table 2).

Table 2. Table of frequency distribution final results and complications of home phototherapy for infants with jaundice.

The final result	Recovery	196	96.6
	Failure	7	3.4
Complication of Prescribing Phototherapy	Hyperthermia	2	28.5
	Restlessness	3	42.8
	Improper technique	1	14.3
	Dehydration	1	14.3

Investigation of the frequency distribution of bilirubin levels in infants with jaundice (before and after phototherapy) shows that the bilirubin levels in infants before phototherapy was (14.2±33.41) and after

phototherapy was (8.2±11.29) that the rate of changes in bilirubin was statistically significant before and after phototherapy (Table 3).

Table 3. Table of frequency distribution of bilirubin levels in neonates with jaundice before and after phototherapy

	Average	Standard Deviation	P. Value
Before phototherapy	14.33	2.41	0.0001
After phototherapy	8.11	2.29	

Pearson and Speberman correlation tests were used to determine the quantitative and qualitative variables to investigate the correlation between neonatal bilirubin and demographic information. The results showed no correlation between neonatal bilirubin level and gender, age, and history of neonatal hospitalization. On the other hand, the results showed a direct correlation between

neonatal bilirubin level with weight, mode of delivery, type of feeding and were statistically significant. Thus, bilirubin levels were higher in infants with higher birth weights infants. After phototherapy, bilirubin levels were also lower in infants with normal childbirth. Finally, the bilirubin of breastfed infants after phototherapy was lower than that of formula-fed infants (Table 4).

Table 4. Correlation coefficient between bilirubin level and studied demographic information after phototherapy

Variable	Correlation coefficient r	p
Gender	-0.08	0.69
Age	-0.14	0.51
Weight	0.59	0.002
Mode of delivery	0.48	0.01
Type of feeding	0.39	0.03
The history of hospitalization	0.17	0.61

DISCUSSION

Early diagnosis and treatment of jaundice in the first days of life can prevent its serious complications. Problems when visiting and hospitalization are among the obstacles to timely action in these patients. The results of various studies showed that home phototherapy is safer and more effective than long-term hospitalization for mature and healthy infants [15, 16]. Problems such as frequent blood samplings, mental and physical stress imposed on parents, the psychological damage caused by turning birthday party into grief for the baby's illness, and the risk of brain damage due to non-referral for repeat testing and treatment can be easily reduced by timely referral for phototherapy at home. Some families try to treat their baby at home and by giving herbal remedies, water, sugar water, stopping breastfeeding, and sometimes placing ordinary incandescent lamp over the baby's head or by putting the baby under sunlight, by these treatments the possibility of complications such as diarrhea and gastrointestinal infections, hyperthermia of the baby and injury to the baby's brain increases [7]. Complications of home phototherapy, in addition to lack of proper nursing and proper supervision-which is the reason why some scientists disagree with this method of treatment-, include corneal damage due to improper uses of eye protection, severe weight loss due to inadequate breastfeeding, changes in body temperature, significantly increased body temperature, insufficient bilirubin reduction. These complications can be reduced by following the rules and regulations provided by the Neonatal Scientific Associations [17, 18].

In the present study, the bilirubin level in infants before phototherapy was 14.33, and after phototherapy were 8.11 and the rate of bilirubin changes significantly before and after phototherapy. In a study, home phototherapy was compared with in-hospital phototherapy for term infants with hyperbilirubinemia, and it was concluded that the mean decrease in serum bilirubin on the first day after treatment was not similar in the two groups and the decrease in the group with phototherapy at home, the reduction in bilirubin was more significant. In the infants

who received phototherapy at home, jaundice improved more remarkably [19]. The results of this study are in line with the present study. Jackson et al. conducted a study in which 32 infants with no side effect physiological jaundice underwent phototherapy at home. All of them showed an acceptable reduction in serum bilirubin with home treatment and none of them needed it to be readmitted to the hospital for phototherapy. They felt very satisfied with home phototherapy and reported minimal side effects of phototherapy [20], which is consistent with our study. In another study conducted in Malaysia, the effectiveness of home phototherapy compared to hospital phototherapy in healthy (term) neonates' hyperbilirubinemia with no side effect was studied. In this study, the mean daily decrease in serum bilirubin concentration in the phototherapy group at home was significantly higher than the phototherapy group in the hospital. Phototherapy-related complications were mild and similar in both groups [16]. The results of this study also showed the effectiveness of phototherapy at home, which we reached a similar result in the present study. Walls et al. in a study in the UK wanted to examine the acceptance of families for treatment of neonatal jaundice at home showed that due to not separation of mother and baby and observation of bilirubin reduction and jaundice in infants, families had good acceptance and with proper education and social support, phototherapy at home can be used as a safe method and in normal childbirth, the reduction of neonatal bilirubin compared to cesarean childbirth was evident [21], which is similar to our study. In a prospective study, in another study found that only 54 percent of infants with high risk hyperbilirubinemia and need for phototherapy, despite all the guidelines for phototherapy in the American academy, was treated. In this study, parents' fear of hospitalization of their infant was mentioned as the reason for not to treat patients with hyperbilirubinemia in a timely manner [22]. The results of this study indicate the importance of phototherapy at home, which is a confirmation of the effectiveness of phototherapy at home. We also came to this conclusion in our study.

In the study of the characteristics of home phototherapy in infants with jaundice in Iran showed that, home phototherapy resulted to a good reduction in infant bilirubin, so this method is a good choice for pediatricians to treat physiological jaundice in healthy term infants [23], which is consistent with our study. In their study that evaluated home phototherapy for neonatal hyperbilirubinemia showed that infant phototherapy at home supported treated without side effects in infants. Further research is needed to investigate the advantages and disadvantages of this method [24]. Finally, in infants with jaundice, if left untreated, if the prevalence of neurodevelopmental disabilities, respiratory diseases, and injuries resulting from higher intensive care survives[23] these infants will be less able to adapt socially, psychologically, and physically[25].

Unfortunately, this study and previous studies did not have a control group to compare the effect of home phototherapy on neonatal jaundice with different levels of bilirubin and its effect on reducing hospitalization of jaundiced neonates. A large and comprehensive study is proposed to evaluate the effect of home phototherapy in reducing the number of yellow neonatal hospitalizations

CONCLUSIONS

Due to the low prevalence of complications and the short duration of treatment, it can be concluded that phototherapy at home can be a good alternative for the treatment of neonatal jaundice. Home phototherapy is applicable and effective in the economic, health and cultural conditions of Iran, but it seems that home phototherapy is a method that for widespread uses in Iran requires the work of a team of skilled and trained human resource and strengthening the monitoring system and insurance coverage. Therefore, this method is recommended for the treatment of neonatal jaundice through proper phototherapy training at home.

ACKNOWLEDGMENTS

This study is the result of a research project in the Research Ethics Committee of Urmia University of Medical

Sciences. The cooperation of the participants in the study is hereby thanked and appreciated.

ETHICAL CONSIDERATION

All stages of this research are based on patient confidentiality and the principles of the Helsinki Resolution and have been approved by the University Ethics Committee (code of ethics IR.UMSU.REC.1396.416). Parents of all patients participating in the informed consent plan and they were excluded from the study if they were unwillingness.

Conflicts of interest

The authors declared that there was no conflict of interest in this study.

Financial support and sponsorship

The article has been derived from a research project with design code 9609663306. This study was financially supported by Urmia University of Medical Sciences, Urmia, Iran.

REFERENCES

1. GolshanTafti M., Eftekhari F., Shajari A., 2019. The Effects of Probiotics on Indirect Bilirubin Level in the Infants with Neonatal Jaundice. Alborz University Medical Journal. 8(1), 61-8.
2. Teixeira M.H, Borges V.M.S., Riesgo R.D.S., Sleifer P., 2020. Hyperbilirubinemia impact on newborn hearing: a literature review. Revista da Associação Médica Brasileira. 66(7), 1002-8.
3. Maisels M., 2005. Prevention and management of neonatal hyperbilirubinemia. Avery's Neonatology Pathophysiology & Management of the newborn 6th ed Philadelphia. 825-33.
4. Muniyappa P., Kelley D., 2020. Hyperbilirubinemia in pediatrics: Evaluation and care. Current Problems in Pediatric and Adolescent Health Care. 50(8), 1038-42.
5. Burke B.L., Robbins J.M., Mac Bird T., Hobbs C.A., Nesmith C., Tilford J.M., 2009. Trends in hospitalizations

- for neonatal jaundice and kernicterus in the United States, 1988–2005. *Pediatrics*. 123(2), 524-32.
6. Mesić I., Milas V., Međimurec M., Rimar Ž., 2014. Unconjugated pathological jaundice in newborns. *Collegium Antropologicum*. 38(1), 173-8.
7. Khatami F., Soltani M., 2007. Home phototherapy; an alternative method for treatment of jaundice in healthy-term newborns. *Iranian Journal of Pediatrics*. 17(s2), 193-8.
8. Chu L., Qiao J., Xu C., 2020. Home-Based Phototherapy versus Hospital-Based Phototherapy for Treatment of Neonatal Hyperbilirubinemia: A Systematic Review and Meta-Analysis. *Clinical Pediatrics*. 59(6), 588-95.
9. Keyvanfar S., Sadeghnia A.R., Namnabati M., 2020. The effects of a neonatal critical Care nurse Companionship with Parents during hospital-home transfer of preterm infants on mothers' mood status. *Nursing and Midwifery Studies*. 9(1), 16-20.
10. Juarez M.C., Grossberg A.L., 2020. Phototherapy in the Pediatric Population. *Dermatologic Clinics*. 38(1), 91-108.
11. Sardari S., Mohammadizadeh M., Namnabati M., 2019. Efficacy of Home Phototherapy in Neonatal Jaundice. *Journal of Comprehensive Pediatrics*. 10(1). e82630.
12. Snook J., 2017. Is home phototherapy in the term neonate with physiological jaundice a feasible practice? A systematic literature review. *Journal of Neonatal Nursing*. 23(1), 28-39.
13. Khatami F., Soltani M., 2007. Home phototherapy; an alternative method for treatment of jaundice in healthy-term newborns. *Iranian Journal of Pediatrics*. 17(2), 8-193.
14. Zareipour M., Sadaghianifar A., Valizadeh R., Alinejad M., Noorani S., Ghelichi Ghoghogh M., 2017. The Effect of Health Promoting Schools Program in Improving the Health Status of Schools in Urmia, North West of Iran. *Int J Pediatr*. 5(2), 4319-27.
15. Stevenson D.K., 1986. Home phototherapy: risks versus benefits. *Clinical Pediatrics*. 25(6), 300-2.
16. Zainab K., Adlina S., 2004. Effectiveness of home versus hospital phototherapy for term infants with uncomplicated hyperbilirubinemia: a pilot study in Pahang, Malaysia. *Med J Malaysia*. 59(3), 395-401.
17. Wu C., Löfqvist C., Smith L.E., VanderVeen D.K., Hellström A., 2012. Importance of early postnatal weight gain for normal retinal angiogenesis in very preterm infants: a multicenter study analyzing weight velocity deviations for the prediction of retinopathy of prematurity. *Archives of Ophthalmology*. 130(8), 992-9.
18. Blencowe H., Lawn J.E., Vazquez T., Fielder A., Gilbert C., 2013. Preterm-associated visual impairment and estimates of retinopathy of prematurity at regional and global levels for 2010. *Pediatric Research*. 74(1), 35-49.
19. El-Beshbishi S.N., Shattuck K.E., Mohammad A.A., Petersen JR., 2009. Hyperbilirubinemia and transcutaneous bilirubinometry. *Clinical Chemistry*. 55(7), 1280-7.
20. Bhutani V.K., Johnson L.H., Schwoebel A., Gennaro S., 2006. A Systems Approach for Neonatal Hyperbilirubinemia in Term and Near-Term Newborns. *Journal of Obstetric, Gynecologic & Neonatal Nursing*. 35(4), 444-55.
21. Walls M., Wright A., Fowle P., Irvine L., Hume R., 2004. Home phototherapy in the United Kingdom. *Archives of Disease in Childhood-Fetal and Neonatal Edition*. 89(3), F282-F.
22. Atkinson L.R., Escobar G.J., Takayama J.I., Newman T.B., 2003. Phototherapy use in jaundiced newborns in a large managed care organization: do clinicians adhere to the guideline? *Pediatrics*. 111(5), e555-e61.
23. Golshan Tafti M., Golzari S., 2018. Characterization of Phototherapy at Home in Neonatal with Jaundice. *Alborz University Medical Journal*. 7(4), 257-65.
24. Chang P.W., Waite W.M., 2020. Evaluation of home phototherapy for neonatal hyperbilirubinemia. *The Journal of Pediatrics*. 220(3), 80-5.
25. Zareipour M., Sadaghianifar A., Ghelichi Ghoghogh M., Ebrahimi H., Asgharzadeh P., Valizadeh R., 2017. The Relationship between Developmental Growth of Children and Anthropometric Indices in Urmia City, North West of Iran. *Int J Pediatr*. 5(5), 4975-84.

