

Rational Use of Phototherapy in the Treatment of Physiologic Jaundice Neonatorum

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ABSTRACT

Jaundice neonatorum is yellowing of skin and other tissues of new born infants. Most infants develop visible jaundice due to elevation of conjugated concentration during their first week. This common condition is called Physiologic Jaundice. Infants with neonatal jaundice are treated with colored light therapy, called Phototherapy. The study was conducted to define and determine the role of phototherapy in the prevention and control of neonatal jaundice. 40 neonates were selected randomly presenting with the complaint of physiologic jaundice and data was collected. The result of this study provides some evidence that photo therapy is effective in treating neonatal jaundice and they recover more rapidly if they are full term and having no associated disease. It is concluded that phototherapy has a very effective role in the prevention and control of jaundice either in initial stage or in complicated cases. Hygienic conditions should be improved in our hospitals to avoid and prevent the associated diseases with jaundice (like urticarial, sepsis etc) which a baby can get after birth. New advanced techniques i.e Billiblanquet & Fibre optics should be introduced in our country to enhance the effectiveness of the phototherapy.

Key words: jaundice neonatorum (JNN), phototherapy, billiblanquet, fibre optics

INTRODUCTION

Neonatal jaundice is a yellowing of the skin and other tissues of a newborn infant. A bilirubin level of more than 85 $\mu\text{mol/l}$ (5 mg/dL) manifests clinical jaundice in neonate. In newborns jaundice is detected by blanching the skin with digital pressure so that it reveals underlying skin and subcutaneous tissue. Jaundice newborns have an apparent icteric sclera, and yellowing of the face, extending down onto the chest. This condition is common in upwards of 70% of newborns.[1]

Notoriously inaccurate rules of thumb have been applied to the physical exam of the jaundiced infant. Some include estimation of serum bilirubin based on appearance. One such rule of thumb includes infants whose jaundice is restricted to the face and part of the trunk above the umbilicus, have the bilirubin less than 204 $\mu\text{mol/l}$ (12 mg/dL) (less dangerous level). Infants whose palms and soles are yellow, have serum bilirubin level over 255 $\mu\text{mol/l}$ (15 mg/dL) (more serious level). But studies have shown that trained examiners assessment of levels of jaundice show moderate agreement with icterometer bilirubin measurements. [1]

The aim of clinical assessment is to distinguish physiological from pathological jaundice. The sign which helps to differentiate pathological jaundice of neonates from physiological jaundice of

neonates are presence of intrauterine retardation, stigma of intrauterine infections (e.g. cataracts, microcephaly, hepatosplenomegaly etc.), cephalhematoma, bruising, signs of intra ventricular hemorrhage etc. History of illness is noteworthy. Family history of jaundice and anemia, family history of neonatal or early infant death due to liver disease, maternal illness suggestive of viral infection (fever, rash or lymphadenopathy), Maternal drugs (e.g. Sulphonamides, anti-malarials causing hemolysis in G-6-PD deficiency) are suggestive of pathological jaundice in neonates. [2]

In the neonate, hyperbilirubinaemia is usually due to a combination of an increased bilirubin load and decreased bilirubin elimination. Despite an understanding of the enzymatic pathways leading to bilirubin production and elimination, very few pharmacological interventions to prevent hyperbilirubinaemia are utilized and the mainstay of treatment remains phototherapy. Previously studied pharmacological agents such as D-penicillamine, phenobarbital and clofibrate may yet prove useful. Recent clinical trials using metalloporphyrins to inhibit heme catabolism and bilirubin production provides a novel pharmacological intervention for the treatment of neonatal jaundice.[3]

The bilirubin levels for initiative of phototherapy varies depends on the age and health status of the newborn. However any newborn with a total serum bilirubin greater than 359 umol/l (21 mg/dL) should receive phototherapy [4]

Infants with neonatal jaundice are treated with colored light called phototherapy. Blue light is considered to be the most appropriate in reducing bilirubin level that causes neonatal jaundice [5]

Exposing infants to high levels of colored light changes trans-bilirubin to the more water soluble cis-form which is excreted in the bile.[6]

Phototherapy works through a process of isomerization that changes trans-bilirubin into the water-soluble cis-bilirubin isomer[7,8]

Green light is not commonly used because exposure time must be longer to see dramatic results [9]

Ultraviolet light therapy may increase the risk of or skin moles, in childhood. While an increased number of moles is related to an increased risk of skin cancer [10,11,12] it is not ultraviolet light that is used for treating neonatal jaundice. Rather, it is simply a specific frequency of blue light that does not carry these risks. Increased feedings help move bilirubin through the neonate's metabolic system. [13]

The light can be applied with overhead lamps, which means that the baby's eyes need to be covered, or with a device called a Billiblanket, which sits under the baby's clothing close to its skin. [14]

Much like with phototherapy the level at which exchange transfusions should occur depends on the health status and age of the newborn. It should however be used for any newborn with a total serum bilirubin of greater than 428 umol/l (25 mg/dL). [15]

Prolonged hyperbillirubinaemia (severe jaundice) can result into chronic bilirubin encephalopathy (kernicterus). Quick and accurate treatment of neonatal jaundice helps to reduce the risk of neonates developing kernicterus.[16]

An effect of kernicterus is a fever. A male full term neonate had hyperbillirubinaemia (kernicterus) and jaundice at the age of 4 days old. He displayed symptoms of increased

lethargy, refusal to eat, and had a fever. The neonate who was diagnosed with kernicterus displayed symptoms of a fever.[17]

Another effect of kernicterus is seizures. The Neonatal Unit at Allied Hospital Faisalabad studied 200 neonates of either gender who presented seizures during their hospital stay from April 2003 to June 2004. The seizures were evaluated and one cause of the seizures was kernicterus. 4.5%, or 9 neonates, displayed seizures caused by kernicterus.[18] High pitched crying is an effect of kernicterus. Scientists used a computer to record and measure cranial nerves 8, 9 and 12 in 50 infants who were divided into two groups equally depending upon bilirubin concentrations. Of the 50 infants, 43 had tracings of high pitched crying.[19]

If a baby and mother have different blood types, sometimes the mother produces antibodies that destroy the newborn's red blood cells. This causes a sudden buildup of billirubin in the baby's blood. This serious type of jaundice usually begins during the first 24 hours of life. Rh problems formerly caused the most severe form of jaundice. However, they are now preventable if the mother is given an injection of RhoGAM within 72 hours after delivery. This prevents her from forming antibodies that might endanger other babies she has in the future. [20, 21]

Clinical criteria to assess Jaundice in Neonates

<i>Area of body</i>	<i>Range of billirubin mg/100ml</i>
Face	4-8
Upper trunk	5-12
Lower trunk & thighs	8-16
Arms & lower legs	11-15
Palms & soles	>15

MATERIAL AND METHOD

The present project work was conducted at Services Hospital, Children Hospital, Jinnah Hospital, Ganga Ram Hospital, Lady Wallingdon Hospital, Mayo Hospital, and Fatima Memorial Hospital. The basic aim was to see the rational use of phototherapy for treatment of physiologic neonatal jaundice. For this purpose medical record of 40 neonates were studied and their history was

taken. A form was developed and filled for each neonate. Sample for this study came from 7 different Hospitals of Lahore.1st sample group include 10 neonates from Sir Ganga Ram Hospital Lahore.2nd sample group include 6 neonates from Lady Willingdon Hospital Lahore.3rd sample group include 7 neonates from Jinnah Hospital Lahore.

4th sample group include 5 neonates from Mayo Hospital Lahore.5th sample group include 5 neonates from Services Hospital Lahore. 6th sample group include 4 neonates from Children Hospital Lahore and 7th sample group include 3 neonates from Fatima Memorial Hospital Lahore.3 weeks (11th June 2009-1st July 2009) Neonates with definite diagnosis of physiologic jaundice. Neonates with diseases other than physiologic jaundice were excluded. This is a retrospective descriptive study. Study was carried out to determine prevalence of jaundice in the people from rural/urban area having educated/non educated background and poor, mediocre or rich socioeconomic status. For this purpose steps were taken. Neonates having jaundice were studied, Weights of the neonates were noted, Age of the neonates were noted, Neonate lab reports were studied, Associated diseases other than jaundice were also noted and Neonate history and family history were also noted.

RESULT:

40 neonates having jaundice were studied. They have undergone with the treatment of phototherapy in order to reduce the level of bilirubin in their blood. Figure 1 showing that female population is at more risk than the male population. 55% of female cases were seen and 45% were male. Whereas the Figure 2 revealed that the preterm babies were the victim of jaundice more often, 57.50% pre term cases encountered jaundice, 37.50% normally delivered and 5% post term babies. Figure 3 shows that out of 40 neonates, some have associated diseases other than jaundice. 30% ANN, 10% hypothermia, 5% ABO incompatibility and 3.5% sepsis were noted. Figure 4 shows that the Photo therapy has many side effects like skin rashi.e 5 %, dehydration 2.5%, motion sickness 2.5% so

most prevelant seen was skin rash. Figure 5 shows that Most of the neonates were having billirubin level between 15-20 mg/dl.

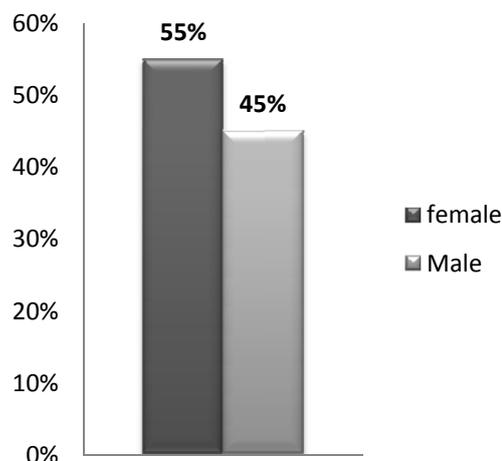


Figure 1

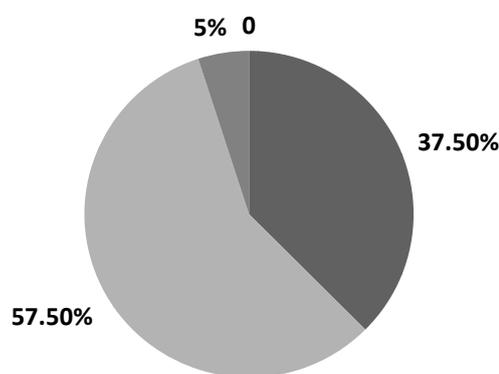


Figure 2

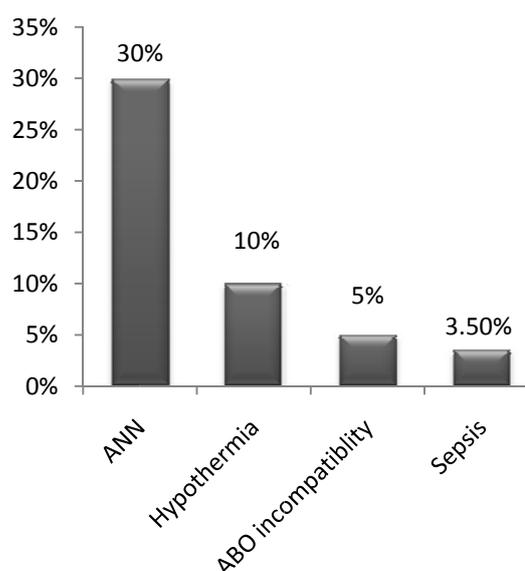


Figure 3

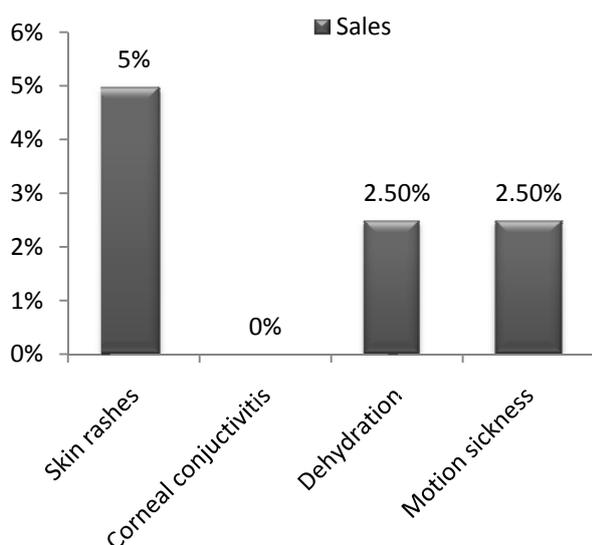


Figure 4

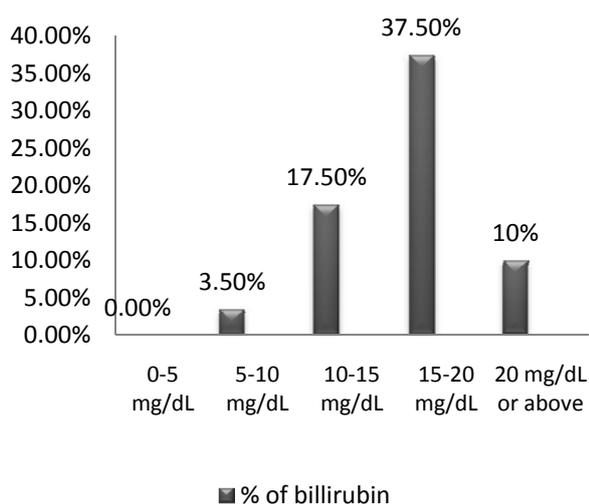


Figure 5

DISCUSSION

Neonatal jaundice is yellowing of skin and other tissues of new born infants. Jaundice occurs when there is a build-up of a naturally occurring substance in the blood called billirubin .JNN can be dangerous if not treated because prolonged hyperbillirubinaemia (severe jaundice) can result into chronic billirubin encephalopathy (kernicterus). Quick and accurate treatment of neonatal jaundice helps to reduce the risk of neonates developing kernicterus. An effect of kernicterus is feverand seizures. It was observed that ratio of neonates suffering from jaundice in Govt Hospitals is

more than in Private hospitals. Few reasons of increased ratio of JNN among people, coming to Govt. sector are negligence, poverty, illiteracy, malnutrition, errors occur in taking medication etc. A great ratio of people of Pakistan is illiterate. Mothers mostly take OTC’s without consulting health care Professionals. Also, these instructions are only given in some private hospitals and clinics. In our society, there is a need to educate people about the importance of balanced diet, the causes of neonatal jaundice and how to avoid disease disasters.

The ratio of occurrence of JNN in preterm is more than in full term neonates. Jaundice occurs when there is a build-up of a naturally occurring substance in the blood called billirubin. To treat this hyperbillirubinaemia phototherapy is given. Photo therapy is the treatment with light in which a newborn with jaundice may be "put under the lights." especially under blue light, with babies’ eyes and external genitalia covered properly.

Phototherapy involves exposure of the naked baby to blue light of wave length 450-460nm. Blue light is preferred as it has least side effects. Routine Lab tests are done to monitor the billirubin level. Intensive photo therapy should result in a total serum billirubin decline 1-2 mg/dL within 4-6 hours. If does not occur, it is considered as a failure of photo therapy. Term infants who are clinically jaundiced for <24 hours are not considered healthy and require further evaluation. If bilirubin level is less than or equal to 15 then phototherapy is given, if more than 15 then exchange transfusion is preferred. Various side effects are associated with phototherapy i-e loose bowel movements, skin rash, dehydration, eye conjunctivitis but it was observed that very few neonates encountered any of these side effects which shows that phototherapy is the best recommended therapy and best treatment of choice for JNN.

It was observed that in Govt. hospitals hygienic conditions were poor so neonates encounter other associated diseases too along with jaundice. So the effectiveness of photo therapy also reduces. In present times, there is a great need to improve hygienic conditions at Govt. scale too.

In foreign countries other advanced techniques are in use to treat JNN along with phototherapy which includes billiblanquet, fibre optic technique etc. Billiblanquet is as an alternative and/or additional treatment for neonatal jaundice. This system uses fiber optics and represents advanced technology in phototherapy treatment given in the hospital or at home. The billiblanquet can be used 24 hours a day to provide continuous treatment if prescribed by the doctor. These advanced techniques should be introduced in every hospital of our country that will lead to better provision of care and treatment to the jaundiced neonates.

CONCLUSION

Jaundice is not exclusively a disease of the poor, deprivation associated with poverty increases the risks of infection and development of disease. There are clear associations between risk of jaundice and malnutrition, overcrowding and negligence. Recognizing jaundice as a social, economic and political disease, and not just a medical problem, prompts the need to explore new avenues through which efforts to ensure jaundice prevention and access to jaundice cure to be strengthened.

Though the reason for incidence of neonatal jaundice is multifactorial, it is within the capability of the world to re-exert control providing that the political will is present. Current events would suggest that the situation will deteriorate further before the International community provides sufficient resources to regain the upper hands in the war against jaundice.

The rational use of photo therapy is to provide blue light of appropriate intensity from a suitable distance and cover the eyes and external genitalia of neonates. The bilirubin level should be monitored at regular intervals. The neonates must be provided with hygienic conditions in order to minimize the risks of associated diseases (i.e; skin rashes, motion sickness etc).

Jaundice is the most common condition that require medical attention in newborns. Though it is treated with blue light therapy in

Pakistan but still a wide margin of improvement of this therapy is present. This therapy can be made effective by using billiblanquets and fibre optic techniques.

RECOMMENDATION

The identification of neonates at high risk and an accurate management of their therapy are the important challenges for health care professionals to avoid serious consequences caused by neonatal jaundice. Consider the following tips, which, if followed, are highly effective in treating neonatal jaundice.

- Illiteracy, unawareness, negligence, unhygienic conditions and malnutrition are the major causes of many diseases including jaundice, in our country. So in accordance, mothers should be given proper guidelines about the nutrition and diet they should take during pregnancy & also medicines they should avoid during pregnancy. For this purpose state & local health dept. should establish a comprehensive informational & investigational program to ensure that proper guidelines are followed.
- Hygienic conditions should be improved in our hospitals to avoid & prevent the associated diseases with jaundice (like urticaria, sepsis etc) which a baby can get after birth.
- Institutions must implement precautions to reduce the risk of jaundice.
- Seminars should be conducted for awareness of the causes & prevention of neonatal jaundice.
- Many causes of the neonatal jaundice can be avoided or managed safely if proper precautions are taken by the pregnant ladies. They should go for routine checkups and treatment.
- They should follow the instructions of their consultants.
- New advanced techniques i-e Billiblanquet & Fibre optic technique should be introduced in our country to enhance the effectiveness of the phototherapy.

Recommendations for the management of hyperbilirubinaemia in healthy term new born infants

Age (hours)	Total serum bilirubin level mg/dL			
	Consider photo therapy	Photo therapy	Exchange transfusion if intensive photo therapy fails	Exchange transfusion and intensive photo therapy
< 24	-	-	-	-
25 – 48	>12	>15	>20	>25
49-72	>15	>18	>25	>30
>72	>17	>25	>25	>30

Recommendations for the management of hyper bilirubinemia in pre-term infants (sick & well) and sick term infants.

Weight (g)	Well infant (total serum bilirubin level mg/dL)		Sick infant (total serum bilirubin level mg/dL)	
	Photo therapy	Exchange transfusion	Photo therapy	Exchange transfusion
<1500	5-8	13-16	4-7	10-14
1500-2000	8-12	16-18	7-10	14-16

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REFERNCES

[1] Madlon-Kay, Diane J. Recognition of the Presence and Severity of Newborn Jaundice by Parents, Nurses, Physicians, and Ictermeter Pediatrics 1997 100: e3

[2] Lynn C. Garfunkel; Jeffrey Kaczorowski; Cynthia Christy (2002). Mosby's pediatric clinical advisor: instant diagnosis and treatment. Elsevier Health Sciences. pp. 200 Retrieved 14 June 2010.

[3] Phyllis A. Dennery, M.D., Associate Professor of Pediatrics, Department of Neonatal and Developmental Medicine, april 2002; 0098

[4] American Academy of Pediatrics Subcommittee on Hyperbilirubinemia (July 2004). "Management of hyperbilirubinaemia in the newborn infant 35 or more weeks of gestation". Pediatrics114(1):297–

316.doi:10.1542/peds.114.1.297.PMID 152 31951.

[5] Amato M, Inaebnit D (February 1991). "Clinical usefulness of high intensity green light phototherapy in the treatment of neonatal jaundice". Eur. J. Pediatr.150 (4): 274–6.doi:10.1007/BF01955530. PMID 2029920.

[6] Leung C, Soong WJ, Chen SJ (July 1992). "[Effect of light on total micro-bilirubin values in vitro]" (in Chinese). Zhonghua YiXue Za Zhi (Taipei)50 (1): 41–5. PMID 1326385.[7]tokowski LA (December 2006). "Fundamentals of phototherapy for neonatal jaundice". Adv Neonatal Care6 (6):30312.doi:10.1016/j.adnc.2006.08.004P MID 17208161.

[8] Ennever JF, Sobel M, McDonagh AF, Speck WT (July 1984). "Phototherapy for neonatal jaundice: in vitro comparison of light sources". Pediatr. Res.18 (7): 667–70. doi:10.1203/00006450-198407000-00021. PMID 6540860.

[9] Dobbs, R H; R J Cremer (1975-11). "Phototherapy.". Archives of Disease in Childhood50 (11): 833–836. doi:10.1136/adc.50.11.833. ISSN 0003-9888. PMID 1108807

[10] Pullmann H, Theunissen A, Galosi A, Steigleder GK (November 1981). "[Effect of PUVA and SUP therapy on nevocellular nevi (author's transl)]" (in German). Z. Hautkr.56 (21): 1412–7. PMID 7314762.

- [11] Titus-Ernstoff L, Perry AE, Spencer SK, Gibson JJ, Cole BF, Ernstoff MS (August 2005). "Pigmentary characteristics and moles in relation to melanoma risk". *Int. J. Cancer* 116 (1): 144–9. doi:10.1002/ijc.21001. PMID 15761869.
- [12] Randi G, Naldi L, Gallus S, Di Landro A, La Vecchia C (September 2006). "Number of nevi at a specific anatomical site and its relation to cutaneous malignant melanoma". *J. Invest. Dermatol.* 126 (9): 2106–10. doi:10.1038/sj.jid.5700334. PMID 16645584.
- [13] Wood, S. (2007, March). Fact or fable?. *Baby Talk*, 72(2).
- [14] Stokowski LA; Fundamentals of phototherapy for neonatal jaundice. *Adv Neonatal Care.* 2006 Dec;6(6):303-12.
- [15] Venigalla S, Gourley GR; Neonatal cholestasis. *Semin Perinatol.* 2004 Oct;28(5):348-55.
- [16] Watchko JF (December 2006). "Hyperbilirubinemia and bilirubin toxicity in the late preterm infant". *Clin Perinatol* 33 (4): 839–52; abstract ix. doi:10.1016/j.clp.2006.09.002. PMID 17148008.
- [17] Shah Z, Chawla A, Patkar D, Pungaonkar S (March 2003). "MRI in kernicterus". *Australas Radiol* 47 (1): 55–7. doi:10.1046/j.1440-1673.2003.00973.x. PMID 12581055.
- [18] Malik BA, Butt MA, Shamoan M, Tehseen Z, Fatima A, Hashmat N (December 2005). "Seizures etiology in the newborn period". *J Coll Physicians Surg Pak* 15 (12): 786–90. doi:10.2005/JCPSP.786790. PMID 16398972.
- [19] Vohr BR, Lester B, Rapisardi G, et al. (August 1989). "Abnormal brain-stem function (brain-stem auditory evoked response) correlates with acoustic cry features in term infants with hyperbilirubinemia". *J. Pediatr.* 115 (2): 303–8. doi:10.1016/S0022-3476(89)80090-3. PMID 2754560.
- [20] Gómez M, Bielza C, Fernández del Pozo JA, Ríos-Insua S (2007). "A graphical decision-theoretic model for neonatal jaundice". *Med Decis Making* 27 (3): 250–65. doi:10.1177/0272989X07300605. PMID 17545496.
- [21] Rothberg AD, Thomson PD, Andronikou S, Cohen DF (July 1982). "Transient neonatal hyperammonaemia. A case report". *S. Afr. Med. J.* 62 (6): 175–6. PMID 7089816.