Extensive Versus Traditional Phototherapy in Treatment of Neonatal Jaundice

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ABSTRACT:

BACKGROUND:

Neonatal jaundice affects more than 60% of neonates. Phototherapy is the main treatment, and its effectiveness is directly related to the duration of exposure, exposed surface area of the infant, and intensity of light used for phototherapy.

OBJECTIVE:

To determine the role of extensive phototherapy in the treatment of neonatal jaundice and to compare efficacy of extensive phototherapy with traditional phototherapy.

PATIENTS AND METHODS:

Over a period of one month occupying throughout April 2017, 100 cases of neonatal jaundice whom either term or preterm, near term (≥ 35 weeks of gestational age), visited Al-Elwiya Pediatrics Teaching Hospital were collected from day zero age, precisely from 1st hour till 240 hours of age. Half of them were put on traditional phototherapy and other half were on extensive phototherapy depending on clinical grounds and their total serum bilirubin levels according to American Academy of Pediatrics guidelines, where a cutline total serum bilirubin (TSB) level of 20-25 mg/ dl was used to identify a phototherapy type.

RESULTS:

Percentage of improvement in neonates whose treatment included extensive (intensive) phototherapy was 72% compared to 40% for traditional phototherapy, with full term neonates` relative risk (1.9) was higher than preterm (near term babies) (1.7), also males` relative risk (1.84) was higher than females` (1.78), but no significant difference was seen regarding both (gestational age and sex). Breast fed, bottle fed, and mixed fed newborns were improved better in extensive than traditional phototherapy (87.50% vs 41.20%, 55% vs 36.36%, 78.57% vs 45.45%, respectively). Extensive phototherapy was more frequently associated with lethargy as a side effect (12% vs 10%).

CONCLUSION:

Extensive phototherapy was more effective in treating neonatal hyperbilirubinemia (significant p value= 0.0012), but with a slightly higher percentage of lethargy as a side effect (12% vs 10%).

KEY WORDS: neonatal jaundice, traditional phototherapy, extensive phototherapy.

INTRODUCTION:

Hyperbilirubinemia is a common and, in most cases, benign problem in neonates.(1) Jaundice is observed during the 1st week of life in approximately 60% of term infants and 80% of preterm infants.(2)

Jaundice is a yellowish discoloration of the skin and mucous membranes, started when serum levels of bilirubin more than 1-2 mg/dl.(3)

Hyperbilirubinemia in term or late preterm infant greater than 35 weeks` gestation is classified as either physiological or pathological based on age and specific analysis of serum measurement.(4-6)

Because of the potential toxicity of indirect bilirubin, newborn infants must be monitored to identify those who might develop severe hyperbilirubinemia and in rare cases acute bilirubin encephalopathy or kernictures.(5)

During the neonatal period, metabolism of bilirubin is in transition from the fetal stage, during which the placenta is in the principal route of elimination of the lipid-soluble unconjugated bilirubin, to the adult stage, during which water-soluble conjugated form is excreted from the hepatic cells into the gastrointestinal tract.(7-10)

Unfortunately, if serum level of bilirubin exceeds a certain value, irreversible CNS damage occurs. CNS damages are directly related not only to the permeability of the blood-brain barrier and nerve

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cell membranes but also to neonatal susceptibility to injury, all of which are influenced by asphyxia, hypoproteinemia, hyperosmolarity, displacement of bilirubin from its binding sites on albumin by competitive binding of drugs such as sulfisoxazole, acidosis, and increased free fatty acid concentration secondary to hypoglycemia, starvation, or hypothermia and infection.[11-13]

Delay passage of meconium may contribute to jaundice by enterohepatic recirculation after de-conjugation by intestinal glucuronidase.[14-15]

Treatments for jaundice include exchange transfusion, phototherapy, and medication. With abnormally high bilirubin levels, doctors may perform an exchange transfusion, where they exchange the infant's blood with normal blood. Phototherapy is implemented when bilirubin levels are not so high above normal (≤ 20 mg/ dl). The infant is exposed to a fluorescent light called bililight, which causes a chemical change in the bilirubin under the skin and makes it easy to excrete through the liver. Infants may also be given medication to reduce the level of bilirubin, such as phenobarbital., tin-protosoporphyrin (Sn-PP), and tin-mesoporphoryin (SnMP).[5]

Although phototherapy is suggested as the first-line treatment of hyperbilirubinemia in neonates, it may put the infant at the risk of important complications such as retinal (eye) damage, loose stools, erythematous macular rash, purpuric rash, overheating, dehydration, hypothermia, and a benign condition called bronze baby syndrome.[4-6]

Even so, Phototherapy as a measure is still one of the most important approaches to treat neonatal hyperbilirubinemia that has been used in the modern medicine for some decades.[8-9]

OBJECTIVE:

determine the part of extensive phototherapy and to contrast its efficacy in the treatment of neonatal jaundice in comparison with the traditional phototherapy.

PATIENTS AND METHODS:

This is a prospective study performed at the neonatal care unit at Al-Elwiya Pediatrics Teaching Hospital in Baghdad- Iraq, for a period of 30 days during whole April 2017.

Infants (either term or near term ≥ 35 weeks of gestational age) ranged from first hour till 240 hours` age (10th day) whom were admitted to the neonatal care unit, with indirect hyperbilirubinemea that needed phototherapy, were included in this study.

Newborns with complications such as direct hyperbilirubinemia, sepsis, metabolic diseases, and hypothyroidism were excluded, in addition to older babies more than 10 days of age (or 240 hours of age).

Analysis was done for 100 newborns (48 males (48%) and 52 females (52%)) who met the above criteria.

According to clinical decision with the help of TSB (total serum bilirubin) levels, and availability of extensive (intensive) phototherapy; the cases were divided randomly into two groups; first group had 50 newborns received extensive phototherapy and the second group included 50 newborns received traditional phototherapy. Hyperbilirubinemia Guidelines of the American Academy of Pediatrics (AAP) were applied[16], within which a total serum bilirubin (TSB) level of ≥ 20- 25 mg/ dl was eligible for extensive phototherapy, while a traditional one was recommended when a TSB level was below that range in term or near term neonates (≥ 35 weeks` gestational age).

A questionnaire sheet was designed, information was collected from parents of the newborns which included: blood group, and Rh (rhesus factor) of the mother, number of pregnancies, age at admission, gender, age at which jaundice was started, history of jaundice or exchange transfusion in the family and other siblings, type of feeding, activity, and neonate`s laboratory measures (packed cell volume (PCV), total serum bilirubin (TSB), blood group and Rh).

The decision and choice of phototherapy type was made by the attending pediatrician according to the guidelines released by American Academy of Pediatrics, which stated extensive phototherapy to take place when TSB levels exceeded 20 - 25 mg/ dl, while lower levels were eligible for traditional phototherapy.[16]

Other clinical variables were recorded, including weight of babies, they were weighed in light clothing as far as possible. Also, length was measured by a tape measure, and all plotted on a growth chart (World Health Organization Multicenter Growth Reference Study Group).[17]

They were exposed to phototherapy light completely undressed, with their eyes were protected. TSB levels were recorded on admission, after 12 hours of the phototherapy, and at the end of treatment, before discharge.

Data analysis was performed using:

A) Descriptive statistics (frequency and percentage).

B) Inferential statistics (X2 test) where P< 0.05 was considered statistically significant.

RESULTS:

One hundred neonates admitted with jaundice to the neonatal unit of AL-ELWIA teaching

hospital; were included in the study sample analysis. 50 of them were treated with extensive phototherapy, the range of their age was (10-239 hours), and the mean of their ages was 72 hours, mean weight was 3.13 kg.

The other 50 children were treated with traditional phototherapy, the range of their ages was (11-240 hours), and the mean of their age was 71 hours, mean of weight was 3.22 kg.

Improvement was considered when TSB declined more than 5 mg/ dl after 12 hours of phototherapy

Table (1) shows that the percentage of improvement after 12 hours in children who were treated with extensive phototherapy was 72%, while for those who were treated with traditional phototherapy was 40%, so that; the relative risk was 1.8 (those who were included in the extensive phototherapy arm of the study had 1.8-time better chance of improvement than those who were included in the traditional arm).

The difference between results of treatment in both groups was statically significant (X2 test P=0.0012).

Analysis of the results regarding the maturity of the newborns, when preterm, near term (≥ 35- < 37 weeks` gestational age) neonates were compared with full term babies showed improvement of both age groups. This is best clarified in table (2).

Table 1: Outcome of treatment of jaundice with extensive phototherapy compared to traditional phototherapy.

Type of treatment	No. of improved children	No. of non-improved children	Total	percentage of improvement
Extensive phototherapy	36	14	50	72%
Traditional phototherapy	20	30	50	40%
Total	56	44	100	56%

P=0.0012 relative risk= 1.8

Both sexes showed almost equal improvement in the outcome when jaundice was treated with extensive phototherapy versus traditional phototherapy, as noticed from table (3).

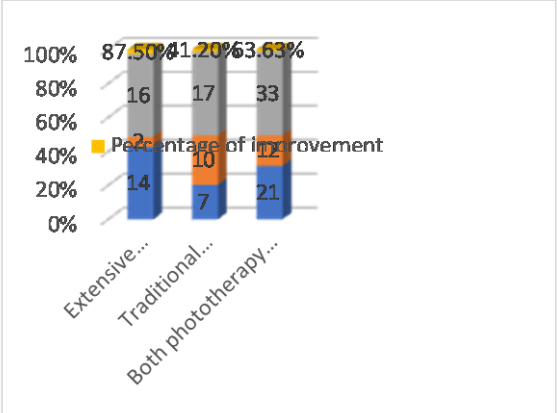
Considering type of feeding; figures (4, 5, & 6) show improvement of outcomes in case of extensive phototherapy whatever the type of feeding was, but the relative risk was more in case of breast feeding compared to bottle feeding (2.12, and 1.51 respectively), while in case of mixed feeding the outcome was somewhere in between (1.73).

Table 2: The outcome of treatment of jaundice in babies with extensive phototherapy and traditional phototherapy in relation to gestational age.

Age	Type of treatment	No. of improved children	No. of non-improved children	Total	percentage of improvement	P value (X2 test)	Relative risk
Preterm, near term (≥ 35- < 37 weeks` gestational age) (n=48)	Extensive phototherapy	17	7	24	70.8%	0.041	1.7
	Traditional phototherapy	10	14	24	41.6%		
	Total	27	21	48	56.2%		
Full term (≥ 37 weeks` gestational age) (n=52)	Extensive phototherapy	19	7	26	73%	0.011	1.9
	Traditional phototherapy	10	16	26	38.4%		
	Total	29	23	52	55.7%		

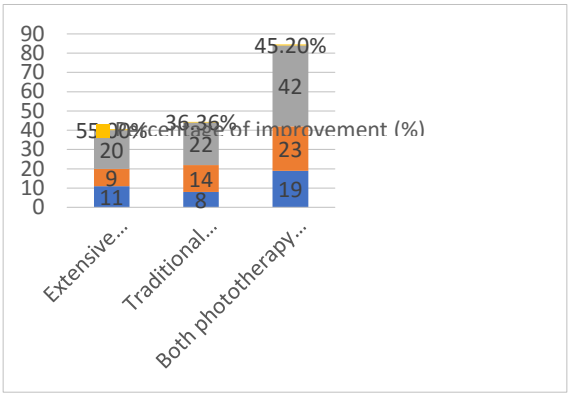
Table 3: The outcome of jaundice in babies when treated with extensive phototherapy versus traditional phototherapy in relation to sex.

Sex	Type of treatment	No. of improved children	No. of non-improved children	Total	Percentage of improvement	P value (X2 test)	Relative risk
Male (n.=48)	Extensive phototherapy	18	7	25	72%	0.019	1.84
	Traditional phototherapy	9	14	23	39.1%		
	Total	27	21	48	56.3%		
Female (n.= 52)	Extensive phototherapy	18	7	25	72%	0.025%	1.76
	Traditional phototherapy	11	16	27	40.7%		
	Total	29	23	52	55.7%		



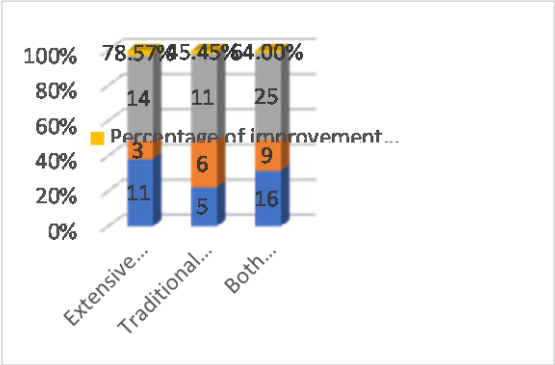
Relative risk = 2.12

Figure 1: Percentage and number of improved breast-fed children affected with jaundice when managed with extensive and traditional phototherapy.



Relative risk = 1.51

Figure 2: Incidence of improvement in bottle fed babies treated with extensive phototherapy and traditional phototherapy.



Relative risk = 1.73

Figure 3: Incidence of improvement of babies on mixed feeding affected with jaundice treated with extensive phototherapy and traditional phototherapy.

Table (4) shows that children treated with extensive phototherapy developed lethargy slightly more than those treated with traditional phototherapy.

Table 4: Effects of extensive phototherapy on occurrence of lethargy.

Type of treatment	Lethargy	No lethargy	Total	Percentage of lethargy
Extensive phototherapy	6	44	73	12%
Traditional phototherapy	5	45	73	10%
Total	11	89	100	11%

Relative risk = 1.16

DISCUSSION:

Our study shows that the percentage of improvement in children who were treated with extensive phototherapy is better than those treated with traditional phototherapy.

Similar results were found by other authors from different parts of the world like Egypt [18], Iran[19], and India[20], but still our results about extensive phototherapy were the best among all, which may be related to the exclusion criteria applied in this work including patients who had hypothyroidism, who were suspected to have sepsis, and those who had inborn error of metabolism.

Full term babies were improved slightly better than preterm ones, with relative risks of 1.9 Vs 1.7 respectively.

A comparable difference was also found by Rami SK et al.[21] with relative risks of 1.62 vs 1.55.

This mild difference in improvement in relation to gestational age may be due to a higher risk of having sepses in preterm compared to full term infants.

Extensive phototherapy was beneficial in both genders almost equally.

A single study performed in Iran[19] showed a little bit better improvement in males compared to females, so no real distinction over males and females.

We noticed breast fed newborns to show better improvement than bottle fed newborns, but unfortunately this was not the opinion of Tan KL[22].

As going with worldwide recommendations that favors breast feeding, more detailed data may be needed to be published relating type of pre-morbid feeding to a final outcome of phototherapy.

Lethargy was more observed in extensive rather than traditional phototherapy groups. Nevertheless; it was not highly frequent and only was seen in a small percentage of patients (12% in comparison to 10%). A study done in China[23] had near results, and such a result may be related

to the hot weather, and the need for extra fluid and feeding when extensive phototherapy was used.

CONCLUSION:

Extensive phototherapy was more effective than traditional phototherapy in the management of jaundice and in decreasing severity and duration of illness even in the absence of pre-existing risk factors.

Extensive phototherapy was also more effective in the management of jaundice in full term, and preterm, near term babies, and in both males and females.

Extensive phototherapy was more beneficial in breast fed babies than in mixed fed and bottle fed babies.

Extensive phototherapy causes more lethargy than traditional phototherapy, so in mild cases of jaundice it might be better to use traditional phototherapy.

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