

## A COMPARISON OF CONVENTIONAL PHOTOTHERAPY AND FIBEROPTIC PHOTOTHERAPY IN MANAGEMENT OF NEONATAL JAUNDICE

Shiv Narayan Panda\*

Classified Specialist (Paediatrics), CHAF, Bangalore PIN: 560007

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### ABSTRACT

**Background:** Phototherapy is the mainstay in the treatment of neonatal hyperbilirubinemia. Conventional and fiberopticphototherapy are the two different modalities. There are insufficient studies to demonstrate the superiority of one modality over the other modality of phototherapy. So this study was conducted to compare the efficacy of Conventional phototherapy vs. fiberopticphototherapy in the management of unconjugated hyperbilirubinemia in healthy term and late preterm neonates in the first week of life.

**Material and Methods:** This is a Randomised prospective study. Healthy term and late preterm babies ( $\geq 35$  weeks) having neonatal jaundice requiring phototherapy as per American Academy of Pediatrics guidelines were randomised to receive Conventional or Fiberoptic phototherapy after satisfying the exclusion criteria. Bilirubin was measured every 12 hourly until phototherapy was discontinued. Primary outcome measure was rate of fall of bilirubin. Secondary outcome measures were duration of phototherapy, failure of phototherapy, need for exchange transfusion and adverse events.

**Results:** 60 neonates were randomised to either Conventional (n=32) and fiberoptic (n=28) phototherapy group. The base line neonatal and maternal characteristics were comparable between the two groups. Significant difference in the rate of fall of bilirubin [ $0.17 \pm 0.03$  mg/dl/hr vs  $0.14 \pm 0.03$  mg/dl/hr;  $p = 0.0005$ ] was noted. The duration of phototherapy between two groups [ $27.37 \pm 7.6$  hrs vs  $31.29 \pm 6.8$  hr;  $p = 0.041$ ] found to be significantly different. There were no failure in phototherapy, no babies required exchange transfusion in both the groups.

**Conclusion:** Both Conventional phototherapy and Fiberoptic phototherapy are safe and efficacious in management of non hemolytic hyperbilirubinemia in the first week of life in healthy near term and term neonates. Conventional phototherapy is found to be superior to fiberoptic phototherapy so far as the duration of phototherapy and rate of fall of bilirubin during management of neonatal jaundice is concerned.

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### INTRODUCTION

Phototherapy is now the preferred method of treatment for neonatal hyperbilirubinemia by virtue of its noninvasive nature and its safety.<sup>1,2</sup> Of the neonates developing hyperbilirubinemia in the first week of life, approximately 10% require phototherapy.<sup>3</sup> Conventional phototherapy and fiberoptic phototherapy are the two different modalities of providing phototherapy to neonates. Conventional phototherapy has a number of disadvantages: the newborn's eyes must be covered<sup>4</sup> and the newborn is usually confined to an incubator. Both maneuvers may inhibit parent-child bonding<sup>5</sup> and eye patching may cause airway obstruction.<sup>6</sup> In addition, conventional phototherapy is delivered as a horizontal band of light energy, incident on the newborn's torso and limbs. Another technique of phototherapy is fiberopticphototherapy which consist of an illuminator unit-the source of the therapeutic light-and a fibre optic panel that

delivers the therapeutic light to the baby. Eye patching and the use of an incubator are apparently unnecessary, and the light transmitted is nearly always perpendicular to the newborn's skin. Two studies suggest that fiberoptic phototherapy is probably as effective as conventional phototherapy.<sup>7,8</sup> We compared these two methods with regard to efficacy, side effects and convenience.

### MATERIAL AND METHODS

A randomized prospective study was conducted on 60 inborn neonates with jaundice who fulfill the inclusion criteria. The study protocol was approved by the Institute's Ethics Committee.

#### Study subjects

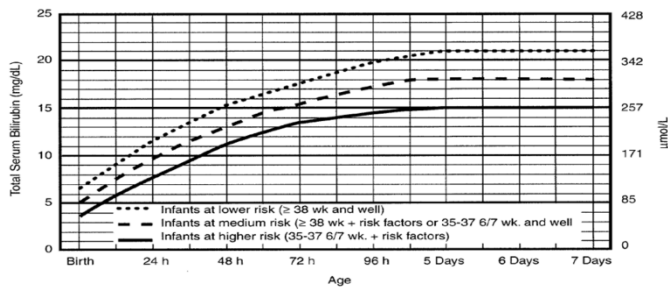
#### Inclusion criteria

Babies who were born at a gestation of  $\geq 35$  weeks and developed jaundice requiring phototherapy within first week of

\*Corresponding author: Shiv Narayan Panda

Department of Clinical Pharmacy, Vaageswari College of Pharmacy, Karimnagar, Telangana

life as per American Academy of Pediatrics practice parameter guidelines as shown in fig 1 were eligible for inclusion in the study.



**Fig 1** American Academy of Pediatrics practice parameter guidelines for the management of hyperbilirubinemia in babies of 35 or more weeks of gestation.

**Exclusion criteria**

Babies with hydrops fetalis, Rh-iso immunization, first serum bilirubin value > 20 mg/dl, sepsis (symptomatic screen positive/ culture positive), babies who developed jaundice requiring phototherapy for the second time and babies with major congenital malformations were excluded from the study.

**Randomization**

After a pilot study of two patients to familiarize the nursing staff with the fiberoptic phototherapy system, the newborns were randomly assigned (using a computer-generated random table) to receive either conventional phototherapy or fiberoptic phototherapy.

**Method of study**

All neonates born at > 35 weeks of gestation were monitored for appearance of jaundice by physical examination by the pediatrician in charge of the baby -12 hrly. Jaundice was assessed by blanching the skin with thumb pressure, revealing the underlying color of the skin and subcutaneous tissue performed in a well-lit room or, preferably, in daylight at a window. Jaundice was assessed based on Kramer’s scale.

TSB was done in all babies who had onset of jaundice > 24 hours, and whose jaundice appeared excess for the corresponding age. Serum bilirubin was estimated by Diazo method with the help of fully Automated Biochemistry Analyser ERBA EM 360 (Transasia Biomedical Ltd).

Two Conventional phototherapy units supplied by Zeal Medical Private Ltd. were used for the study. The unit consisted of 4 special blue tubes and 2 daylight tubes., placed 35 cm above the neonate who was placed naked, except for diaper and eye patches, in an incubator and removed only for feedings. Irradiance was measured by Joey Dosimeter at the center of unit at the level of the baby in Conventional phototherapy.

Fiberoptic phototherapy was provided by “The Wallaby 3 Phototherapy System. The Wallaby is afiberoptic phototherapy system that consist of an illuminator unit- the source of the therapeutic light-and a fibre optic panel that delivers the therapeutic light to the baby. The baby was laid down on the illuminating portion of the fibreopticpad directly and irradiance was measured by dosimeter at the centre of illuminating surface.

All neonates whose TSB levels are in phototherapy range as per AAP guidelines for phototherapy were randomized to receive conventional or fiberoptic phototherapy after satisfying the exclusion criteria. Consent was taken prior to enrollment.

Base line characteristics were noted as per predesigned proforma.

Work up for jaundice was done as per existing protocol in the unit which included- blood group/Rh, Reticulocyte count, Peripheral smear for hemolysis, G6PD levels, serum bilirubin estimation which was done 12 hrly

Neonates under Conventional phototherapy remained naked except for an eye pad and a nappy. Mothers were instructed to note the time duration for which the lights were switched off for activities like feeding, nappy change, for blood sampling etc. A chart was provided to the mother to note the above events. In fiberoptic phototherapy group eyepad was not used.

Baby’s temperature was monitored every eight hourly using digital thermometers by the nursing staff. If babies become hypothermic hot air blowers were used. Loose stools, feed intolerance, skin rashes and other side effects, if any were recorded.

Phototherapy was stopped if 2 values of TSB taken 12 hrs apart were below the cut off for phototherapy as per AAP charts.

**Statistical analysis**

Data was entered in a predesigned proforma in Epi info™ version 3.3.2 (Centers for Disease Control and Prevention, Atlanta, GA). The data was analyzed statistically using Stata software version 9.1 (StataCorp, College Station, TX). Continuous data with normal distribution was analyzed by student *t* test and non-normally distributed data by Wilcoxon log rank test (Mann-Whitney). Categorical data was analyzed by chi-square or Fisher exact test. A *P* value of <0.05 was taken as significant.

**RESULTS**

There were no significant differences in clinical and laboratory characteristics between the two groups at entry into the study. (Table.1,2)

**Table 1** Neonatal characteristics

Neonatal characteristics	Conventional Phototherapy (n=32)	Fiberoptic Phototherapy (n=28)	P value
Gestation (mean ± SD)	38.7 ± 1.4	39.1 ± 1.2	0.299
Birth weight (mean ± SD)	2993 ± 382	2918 ± 378	0.451
Gestation (mean ± SD)	37.4 ± 1.3	37.3 ± 1.4	0.82
Male gender	17 ( 53%)	14 (50%)	1.000
Exclusive breast milk	30 (93.8%)	28 (100%)	0.494

**Table 2** Maternal characteristics

Maternal characteristics	Conventional Phototherapy (n=32)	Fiberoptic Phototherapy (n=28)	P value
Mode of delivery			
Primi	15 (46.8%)	12 (42.8%)	0.80
Vaginal	12 (37.5%)	16 (57.1%)	0.2
Vacuum	3 (9.4%)	3 (10.7%)	1.0
Forceps	0 (0)	0(0)	
Elective LSCS	17 (53.1%)	9( 32.1%)	0.12

The measured irradiance, however was significantly greater in the conventional phototherapy group (29.9 ± 0.6 μW/cm<sup>2</sup>/nm vs 14.9 ± 0.2 μW/cm<sup>2</sup>/nm, p<0.0001) (Table 3.). The mean serum bilirubin level at start and stop of phototherapy are shown in Table 3.

**Table 3** Phototherapy details

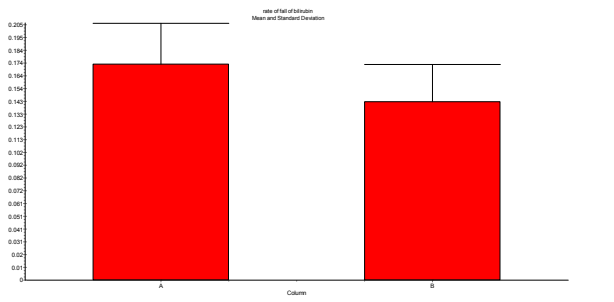
	Conventional Phototherapy (n=32)	Fiberoptic Phototherapy (n=28)	P value
Age at onset (hr)	67.1 ± 11.4	69.9 ± 8.7	0.295
TSB* at start	17.08 ± 1.17	16.98 ± 0.97	0.723
Age at stop	101.3 ± 14.2	108.0 ± 11.8	0.055
TSB at stop	12.43 ± 1.05	12.64 ± 0.73	0.370
Irradiance (μW/cm <sup>2</sup> /nm)	29.9 ± 0.6	14.9 ± 0.2	<0.0001

Values are in Mean ± SD; \*TSB total serum bilirubin in mg/dL

There was significant difference in the primary outcome of rate of fall of bilirubin. The rate of fall being more in the Conventional phototherapy group. The mean (SD) in conventional group being (0.17 ± 0.03 mg/dl/hr) and fiber optic group being (0.14 ± 0.03 mg/dl/hr) with *p* value of 0.0005.

**Table 4** Primary outcome variables

	Conventional Phototherapy (n=32)	Fiberoptic Phototherapy (n=28)	P value
Rate of fall of Bilirubin (mg/dl/hr)	0.17 ± 0.03	0.14 ± 0.03	0.0005



A = Conventional phototherapy group B = Fiberoptic phototherapy

**Fig 2** Box plot showing rate of fall of bilirubin in mg/dL/hr between conventional phototherapy group and fiberoptic phototherapy group

The duration of phototherapy was also significantly different between two groups. The total duration of phototherapy is less in conventional PT than the fiberoptic PT group. The mean (SD) duration in conventional phototherapy group being (27.37 ± 7.6 ) and in fiberoptic phototherapy group being (31.29 ± 6.80 ) with a *p* value of 0.041 (*p*<0.05). (Table 5)

**Table 5** Secondary outcome variables

	Conventional Phototherapy (n=32)	Fiberoptic Phototherapy (n=28)	P value
Actual duration of PT	27.37 ± 7.6	31.29 ± 6.80	0.041*
Exchange Transfusion (%)	0	0	
Failure of phototherapy	0	0	
Need for PT for rebound increase in serum bilirubin	0	0	

\*Mann-Whitney U test

The fiberoptic panel produced no abrasions and there were no rashes, temperature abnormalities, or other side effects in either group of newborns. Several parents expressed satisfaction at being able to hold their child during fiberoptic phototherapy.

**Comment**

Both conventional phototherapy and fiberoptic phototherapy are safe and efficacious in management of non hemolytic hyperbilirubinemia in the first week of life in healthy near term and term neonates. Conventional phototherapy is found to be superior to fiberoptic phototherapy so far as the duration of phototherapy and rate of fall of bilirubin during management of neonatal jaundice is concerned, most likely because of the greater irradiance delivered.

In this study the irradiance as measured by the dosimeter was found to be more with the conventional phototherapy unit, the mean (SD) being (29.9 ± 0.6 μW/cm<sup>2</sup>/nm) in comparison to the fiberoptic phototherapy unit where it was (14.9 ± 0.2 μW/cm<sup>2</sup>/nm). It was unfortunate, although not planned, that we actually compared two different dosages of phototherapy. Our intent was to compare the fiberoptic phototherapy system with the conventional phototherapy system as we currently use it. It may be possible that increasing the irradiance of fiberoptic phototherapy would make it as effective as our conventional phototherapy.

Fiberoptic phototherapy has some advantages over conventional phototherapy. Eye patching is not required and mothers can hold their newborns during phototherapy leading to improved bonding

**References**

1. Granati B, Largajolli G, Rubaltelli FF, et al. Efficacy and safety of the “integral” phototherapy for neonatal hyperbilirubinemia: results of a follow up at six years of age. *ClinPediatr* 1984; 23;483-6
2. Cremer J, Perryman PW, Richards DH. Influence of light on the hyperbilirubinemia of infants. *Lancet* 1958; 1:1094.
3. Kivlahan C, James EJP. The Natural history of neonatal jaundice. *Pediatrics* 1984;74:364-70.
4. Messner KH, Maisels, LeureduPree AE. Phototoxicity to the newborn primate retina. *Invest ophthalmolvis Sci.*1978; 17: 178-182.
5. Fetus and Newborn Committee, Canadian Pediatric Society. Use of Phototherapy for neonatal hyperbilirubinemia. *Can Med Assoc J.* 1986; 134 : 1237-1245.
6. Ai-Salihi FL, Curran V. Airway obstruction by displaced eyemask during phototherapy. *AJDC.* 1975;129:1362.
7. Rosenfeld W, Twist P, Concepcion L. A new device for phototherapy treatment of jaundiced infants. *J Perinatol.*1990; 10:243-248.
8. Gale R, Dranitzki Z, Dollberg S, Stevenson DK. A randomized, controlled application of the Wallaby Phototherapy System compared with standard phototherapy. *J Perinatol.*1990;10:239-242.

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