ORIGINAL ARTICLE

Effectiveness of Home versus Hospital Phototherapy for Term Infants with Uncomplicated Hyperbilirubinemia: A Pilot Study in Pahang, Malaysia

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Summary

A comparative pilot study was conducted to determine the difference in the reduction of total serum bilirubin in a group of infants who had phototherapy at home compared to an in-patient group on hospital phototherapy. Eighteen infants with unconjugated hyperbilirubinaemia who fitted the selection criteria were put under the mobile home unit (Bluelite™ Portable Light) placed in the home. A control group of 18 infants with the same matching characteristics had intense phototherapy in the hospital using a unit with top and bottom light sources. The infants were matched for race, starting total serum bilirubin level, birth weight (up to 250 grams) and age of baby at initiation of phototherapy (up to one-day difference). It was observed that the mean daily decrease in serum bilirubin concentration was significantly more in the home group as compared to the hospital group ($t=2.95$, $df=17$, $P<0.05$). The mean duration of treatment was significantly less for the home group as compared to the hospital group ($t=2.84$, $df=17$, $P<0.05$). None of the infants who had home phototherapy were re-hospitalized. Phototherapy related complications were mild and comparable in both groups. The result suggests that home phototherapy is safe and effective in bringing down the concentration of serum bilirubin for term babies with uncomplicated hyperbilirubinaemia.

Key Words: Neonatal jaundice, Uncomplicated hyperbilirubinaemia, Mobile home phototherapy, In-patient Hospital Phototherapy

Introduction

Neonatal jaundice is a common problem that pediatricians face. Jaundice occurs in 60-70% of term newborns and virtually all preterm infants because of a deficiency that does not allow them to process bilirubin in the liver. If bilirubin levels are excessive, neurologic damage may result. In Malaysia, it has been common practice to expose jaundiced infants to the morning sunlight. Since the observation by Cremer et al[1] in 1958 noted a drop in bilirubin concentrations when newborn infants were exposed to sunlight or blue wavelengths of artificial light, phototherapy has been extensively used to treat neonatal jaundice. Jaundice commonly occurred in breastfeeding infants in whom no cause for the jaundice could be determined and most responded well to phototherapy treatment[2]. Treatment using the bilirubin blanket has proven to be less effective

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compared to the conventional overhead phototherapy unit used in hospitals[3]. In Malaysia, rental of the bilirubin blanket for home phototherapy has been practiced by at least one private medical center.

Home phototherapy has been available to pediatricians in the United States for over 25 years. In a study of home versus hospital phototherapy done by Slater and Brewer[4], the average decrease in serum bilirubin concentration was similar for the two groups after the first day of treatment and no phototherapy related complications were noted in the study infants. In another study by Eggert et al[5] bilirubin levels decreased as rapidly in the home group as in the hospitalized control group, and duration of treatment averaged 2.8 days. They found home phototherapy to be a feasible, safe and effective alternative to in-hospital phototherapy for otherwise healthy, jaundiced infants. In this study, about US $ 18,000 was saved by treating the 62 infants in the study at home compared to treatment of jaundiced infants in hospital. The home phototherapy unit used for this study was designed to provide the same overhead conventional way of phototherapy treatment, with the added advantage that it is mobile and easy to set up in the home. The unit was designed and made in Malaysia with patent pending. This unit has been available for rental in Malaysia since February 2001.

It is the objective of this study to determine the difference in the fall of serum bilirubin in a group of infants who had phototherapy at home compared to another group who had inpatient hospital phototherapy.

Materials and Methods

The study population comprised of all babies born in Tengku Ampuan Afzan Hospital from March 2002 to August 2002 fulfilling the selection criteria. The home group had phototherapy at home using the Bluelite mobile home phototherapy unit (Figure 1). The Bluelite mobile home phototherapy unit has 5 PHILIPS TL20W/52 tubes assembled in a modified Acrylonitrile Butaeiene Styrene (ABS) plastic suitcase. The upper portion of the suitcase when detached and mounted on posts forms the light fitting. The lower portion forms the bassinet.

Reflectors are provided on both sides of the neonate to increase effective coverage of the skin area. A radiator fitted to the light fitting disperses heat away from the neonate making it more comfortable and suitable in Malaysia's tropical environment. The distance from the neonate to the light is 30cm (12 in) and not adjustable. Irradiance level on the neonate's skin at the center of the unit is a minimum of 15.50 µw/cm2/nm. Reflection from the side mirrors give a minimum of 7.75 µw/cm2/nm of irradiance. Measurements were made using a Bilirubin Radiometer from Solar Light Company, USA.

The babies in the hospital group were put under a self-made wooden phototherapy unit (Figure 2). This unit had 12 PHILIPS MODEL TL20W/52 tubes attached to a timber frame above and below the transparent cots. The distance of the baby from the top and bottom lights are 50cm and 30cm respectively. Each unit can have a maximum of 3 babies receiving phototherapy at any one time. Irradiance on the neonates skin was 14 – 16 µw/cm^2 /nm above and 18 – 19 µw/cm^2 /nm below the baby.

The proposal for the study was vetted and approved by the Kulliyah of Medicine Ethics and Research Committee. Approval was also obtained from the Director of Health, Pahang, Malaysia. A standard questionnaire was administered to the mothers which recorded demographical data, feeding history, side effects of phototherapy and the mothers perception as to the ease of using the treatment. A signed consent was obtained from the mothers in the home phototherapy group. The criteria for choosing the study population were based on the Committee on Fetus and Newborn of the American Academy of Pediatrics (AAP) guidelines for Home Phototherapy[6] with some modification (the AAP values are noted in brackets where modifications are made in the criteria). The criteria were:

1. full term infants as defined by infant's gestational age greater than 37 weeks
2. birth weight of 2,500 grams to 4,000 grams
3. five minute Apgar score of 7 or more
4. normal findings on physical examination
5. actively feeding infant
6. stooling and voiding by 24 hours of age
7. greater than 2 days but less than 7 days of age at the start of therapy
8. bilirubin levels above 180 umol/L (239 umol/L) but below 315 umol/L (309 umol/L)
9. no G6PD deficiency, Coombs test –ve, no ABO incompatibility, Rh negative

10. adequate home and parental environment (environment is clean, not too hot, adequate ventilation is available and there is always an adult to supervise the infant under the phototherapy unit) as evaluated by study staff

The selected 18 infants with hyperbilirubinaemia who fulfilled the criteria were the participants in the home phototherapy group. Only 18 infants were chosen because this was the number that fulfilled the set criteria during the study period.

Another 18 infants whose characteristics matched those in the home group were selected to be in the control group. They were treated under the hospital phototherapy equipment. They were matched for ethnic group, starting bilirubin level, birth weight (within the range of ± 250grams) and age of baby when therapy was initiated (up to one day difference). These infants were selected from patients needing phototherapy.

Bluelite mobile home phototherapy units were set up in the home by the technical staff. Parents were given a demonstration on the use of the equipment and the safety precautions that needed to be taken once the baby was placed in the unit. The parents were shown how to protect their baby's eyes. Continuous phototherapy was administered by the parents at home (minimum of 18 hours per day). Record of interruption of phototherapy for feeding, excessive crying, bathing and napkin changes was kept by the parents. During these interruptions, the eye patches were removed. The same instructions were given to the parents of the babies in the hospital. Daily assessment was carried out by the paediatrician at the hospital (the home group of babies were brought to hospital by their parents) and blood was drawn by venepuncture for bilirubin (total and unconjugated) determination. Serum bilirubin level estimation was done using spectrophotometry (Olympus 640, calibrated daily) in a single reference lab. Phototherapy was terminated when the total bilirubin level fell below 200 *u*mol/L. Data was gathered and analyzed using Lotus 123 package.

Results

The socio-demographic data of mothers is shown in Table I. The percentage of Malay babies for the home mobile and hospital non mobile phototherapy was 94.5% and Chinese 5.5%. The majority of mothers from the home group were aged between 30 and 39 years old (55.5%). The majority of mothers from the hospital group were aged between 20 and 29 years old (77.8%). The household income for the respondents fell mainly within a range of RM500 to RM2,000 for both groups (72.3% Home group and 83.3% Hospital group). The educational level of the mothers were mainly secondary for both groups (61.2% Home group and 94.5% Hospital group). There was no significant difference between both groups of mothers in their age, ethnic group, household income and educational level.

The mean weight of the babies was 3.15kg for the home phothotherapy group and 2.93 for the hospital phototherapy group Table II shows the difference between the home group and hospital group in relation to age at start of phototherapy, total bilirubin levels and daily decrease in bilirubin level.

A paired Student's t-test was carried out to determine if there was any significant difference in the results from the home group as compared to the hospital group. There was no significant difference in the mean age at start of phototherapy. The mean duration of treatment for the home group (1.17days ± 0.37 days) was less as compared with the hospital group (1.72 ± 0.73 days) and this difference was significant at (t=2.84, df=17, P = 0.0098). The mean daily decrease in bilirubin levels was more in the home (53.4 ± 36.9 umol/L) group as compared with the hospital group (22.1 ± 25.7 umol/L) and this difference was significant (t=2.95, df=17, P = 0.0074).

Only 3 (16.7%) infants from the home phototherapy group needed to have another day of phototherapy before phototherapy was terminated compared with 9 (50%) infants from the hospital group.

Table III shows the study group complications that developed during phototherapy. There were no major complications that developed using the home therapy unit and hospital unit. There was no significant difference (P=0.606) in the minor complications that arose in both study groups. Table IV shows the distribution of respondents according to method of feeding. All the babies received breast milk. Only 2 from the Home Phototherapy and Hospital Phototherapy group received breastmilk and formula.

Table I: Distribution of Respondents by Sociodemographic Data

Socio Demographic Data	Range	Frequency (%) Home Group	Frequency (%) Hospital Group	Significance Test (X^2 Test with Yates correction)
Ethnic Group	Malays	17(94.5%)	17(94.5%)	Not Significant
	Chinese	1(5.5%)	1(5.5%)	$X^2 = 0$
				P > 0.05
Age	<20	1(5.5%)	0	Not Significant
	20 – 29	10(55.5%)	14(77.8%)	$X^2 = 2.44$
	30 – 39	7(39%)	4(22.2%)	P > 0.05
	>39	0	0	
Household Income	< RM 500	1(5.5%)	0	Not Significant
	RM 500 -1000	6(33.3%)	10(55.5%)	$X^2 = 1.75$
	RM1000-2000	7(39%)	5(27.8%)	P > 0.05
	>RM2000	4(22.2%)	3(16.7%)	
Educational Level (Mother)	Primary	5(27.8%)	0	Not Significant
	Secondary	11(61.2%)	17(94.5%)	$X^2 = 2.03$
	Tertiary	2(11%)	1(5.5%)	P> 0.05

Table II: Comparison of Home Phototherapy Group and Hospital Phototherapy Group

Variable	Home Phototherapy	Hospital Phototherapy	P
Mean age at start of phototherapy (days) Mean $\pm$ SD	3.72 $\pm$ 0.93	3.72 $\pm$ 1.04	1.0 (NS)
Mean Bilirubin at start (umol/L) Mean $\pm$ SD	237.3 $\pm$ 38.7	237.9 $\pm$ 37.7	0.96 (NS)
Mean Bilirubin at termination of phototherapy(umol/L) Mean $\pm$ SD	175 $\pm$ 30.5	199.8 $\pm$ 46.6	0.077 (NS)
Mean Duration of phototherapy(d) Mean $\pm$ SD	1.17 $\pm$ 0.37	1.72 $\pm$ 0.73	0.0098 (P < 0.05)
Mean decrease in bilirubin level (umol/L)	53.4 $\pm$ 36.9	22.1 $\pm$ 25.7	0.0074 (P< 0.05)

Mean $\pm$ Standard Deviation
NS = Not significant

Table III: Study Group Complications

Complications	Home Phototherapy (%)	Hospital Phototherapy (%)
None	14(77.8%)	14 (77.8%)
Skin Rash	1 (5.5%)	2 (11.5%)
Hyperthermia	0	0
Diarhhoea >5x	3 (16.7%)	2 (11.1%)
Vomiting	0	0
Rehospitalization	0	0

X^2 Test: P = 0.606 (P > 0.05) = Not significant

Table IV: Study Group Method of Feeding

Method of Feeding	Home Mobile (%)	Hospital Non Mobile (%)
Fully Breastfeeding	16 (89%)	16 (89%)
Mixed Feeding	2 (11%)	2 (11%)
Fully Bottlefeeding	0	0

Table V: Comparison of Home Phototherapy Groups from Current Study with Eggert et al[5] and Slater & Brewer[4]

	Current Study (n=18)	Eggert et al (n=62)	Slater & Brewer (n=25)
Mean age at start of phototherapy (days)	3.7	4.2	3.9
Mean Bilirubin Level at strart of phototherapy (umol/L)	237.3	260.1	280.5
Mean Bilirubin Level at termination of phototherapy (umol/L)	175	193.8	200.6
Duration of Phototherapy (d)	1.17	2.8	2.8
Mean daily decrease in bilirubin level (umol/L)	53.4	23.7	28.5

Discussion

The results of this study was compared with a similar study carried out by Slater & Brewer[4]. In this study there was a significant difference in the mean daily decrease of bilirubin levels of the home mobile group as compared to the hospital non-mobile group. Slater & Brewer found no significant difference between the two groups. It is possible that the home mobile unit produced a better drop in bilirubin levels because of better access of mother to baby where breastfeeding is sustained on demand as compared to the hospital set-up where there is separation of mother and baby and breastfeeding may not be carried out on demand. Studies have shown that until nursing and milk flow are well established, usually in the first 3 to 5 days after birth, breast –fed infants have been shown to receive fewer calories than their bottle-fed peers[7] and this contributes to the development of jaundice. Thus priority should be given to the establishment of breastfeeding and the home environment is more conducive for this to occur. This study also provided information on feasibility, safety and effectiveness of home phototherapy. No major complications developed and no infant needed to be re-hospitalized during the study period. This finding was consistent with that carried out by Eggert et al[5]. In comparing the results obtained with other studies, it was found that this study found a bigger drop (53.4 umol/L) in total bilirubin levels for the home mobile phototherapy as compared with the other studies (23.7umol/L and 28.5 umol/L). The duration of phototherapy in this study was less by half as compared to the other two studies. This suggests that the home phototherapy unit in this study is more effective in bringing down the level of bilirubin for term babies with physiologic jaundice. Further studies with a higher number of respondents is needed to verify this finding. Table V shows this comparison.

It is noted that both Eggert et al[5] and Slater & Brewer[4] reported successful trial of home phototherapy involving term infants. Slater & Brewer used a standard Olympic "Bililite' for their home phototherapy and Eggert used a fluorescent lamp phototherapy unit provided through Medirec, a home phototherapy rental firm.

From our questionnaire it was noted that all the mothers (100%) found home phototherapy convenient. Personal conversation with the mothers reflected a desire for home phototherapy primarily so that they could continue breastfeeding in the privacy and comfort of their own homes. Hospital treatment of jaundice can interfere with successful breastfeeding[8], therefore home phototherapy may be a viable alternative for breastfeeding mothers. Respondents also cited accessibility to washroom facilities as another important reason. This could be because in the

hospital they share a common area and common washroom facilities which is inconvenient to the mothers. A study by Meropol et al[9] found that 75% of parents were satisfied with home phototherapy. 79% felt that the major parental benefit from home phototherapy was less separation from their newborns. Another study by Jackson et al[10] on 32 babies with uncomplicated physiological jaundice who received home phototherapy found that all babies showed acceptable reductions in their serum bilirubin on home phototherapy and none required re-admission for phototherapy. The families were highly satisfied with the home program and recorded high levels of confidence in their therapeutic responsibilities.

There were no problems with compliance in this study. All the mothers using the home mobile phototherapy unit followed instructions to sustain phototherapy for a minimum of 18 hours and all complied with the application of eye patches. This would allay the anxiety of pediatricians who would not use the mobile unit for reasons of non-compliance. Meroopol. et al[9] found that one of the reasons pediatricians were non users of home phototherapy were fears that parents would not comply with phototherapy itself or would not apply eyeshields (40%). Another reason was medico legal concerns (37%) which in this study is covered by having parents sign a consent form and a form stating that they would follow all written instructions.

Costs should also be considered when evaluating home phototherapy to hospital phototherapy. In the government hospitals, bed availability is always a problem. If all normal term infants with physiologic jaundice can be treated at home, it would make available a bed in the pediatric unit for more deserving patients. Patients in the rural areas also prefer to bring home their jaundiced babies and expose them to the morning sun. The availability of home phototherapy in Village Clinics (Klinik Desa) manned by the Village Staff Nurse (Jururawat Desa) could contribute to more effective treatment of these cases. A study by Plastino R. et al, showed that small variations in criteria for phototherapy can cause large effects in the cost of medical care. Most savings occurred because of a reduction in the number of babies treated. Cost of therapy in the private hospital in Malaysia can be expensive (RM400 per day – adding the cost for the nursery stay, phototherapy equipment, mother's stay, medical supplies usage and nursing charges) especially if jaundice is prolonged. Home phototherapy (RM60 per day) would be a moreaffordable alternative.

Conclusion

Home phototherapy is a feasible and safe alternative to in-hospital phototherapy for carefully selected, otherwise healthy infants, with hyperbilirubinemia as their sole problem. All cases of home phototherapy should be under a paediatricians care who would determine the initial level of bilirubin and suitability for home phototherapy.

Parents must be capable of following instructions and of assessing when to call their physician regarding problems. They must bring the baby for bilirubin evaluation as stipulated by the pediatricians. Paediatricians must be as vigilant following serial bilirubin levels of infants treated at home as they are with similar hospitalized infants. This study suggests that home phototherapy is feasible, safe and effective alternative to in-hospital phototherapy for selected newborns with motivated parents. It should not replace in-hospital phototherapy for infants with multiple problems, inadequate home facilities, or poorly motivated parents. Further studies with a bigger study population is needed to verify the results of this study.

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