Clear Topical Ointment Decreases Transepidermal Water Loss in Jaundiced Preterm Infants Receiving Phototherapy

SIRIWAN WANANUKUL, M.D.*,
PRAMOTE PRAISUWANNA, M.D.**

Abstract

The evaporation rate (ER) from the skin was measured in 40 jaundiced preterm infants born at less than or equal to 34 weeks of gestation. The baseline measurements were executed in both the right and left side in 3 positions: upper arm, back and lower leg. The patients were randomly recruited to a treatment or a control group. The treatment group received 3.0 ml of clear topical ointment just before phototherapy. Conventional phototherapy was placed above the incubators in both groups. ER and ambient skin temperature were measured at the same point at 30 minutes and 5 hours during phototherapy.

In the control group, ER was increased by 8.0 per cent (P value = 0.01) and 14.5 per cent (P value < 0.001) at 30 minutes and 5 hours during phototherapy, respectively. In the treatment group, clear topical ointment decreased ER by 19.2 per cent (P value < 0.001) and 13.2 per cent (P value = 0.003) at 30 minutes and 5 hours during phototherapy, respectively. Ambient skin temperature during phototherapy was increased significantly (P <0.01) in both groups. Serum microbilirubin difference of pre and post phototherapy at 24 hours of phototherapy between the 2 groups was not significantly different (P=0.38). The authors concluded that conventional phototherapy, in premature infants nursed in an incubator, increased transepidermal water loss (TEWL) significantly and the application of clear topical ointment on the skin of jaundiced preterm infants receiving conventional phototherapy in incubators reduce TEWL significantly, without effect on serum microbilirubin.

Key word : Evaporation Rate, Phototherapy, Preterm Infant, Clear Topical Ointment

WANANUKUL S, PRAISUWANNA P
J Med Assoc Thai 2002; 85: 102-106

* Division of Pediatric Dermatology,
** Division of Neonatology, Department of Pediatrics, Faculty of Medicine, Chulalongkorn University, Bangkok 10330, Thailand.

Hyperpilirubinemia is a common problem in premature infants. Phototherapy is an effective means of preventing or treating hyperbilirubinemia (1). During phototherapy, there is a marked increase in insensible water loss in premature infants which may be as much as 80 per cent to 190 per cent in non-servocontrolled incubators(2). In extremely premature infants, transepidermal water loss (TEWL) may result in significant morbidity secondary to dehydration, electrolyte imbalance and thermal instability(3). Topical ointment therapy can decrease TEWL in premature infants(4). The authors found that conventional phototherapy increased TEWL in term infants with nonhemolytic hyperbilirubinemia(5). Clear topical ointment applied on half of the body can decrease TEWL during phototherapy compared to the untreated side(6). When clear topical ointment is applied on one side, there might be a compensatory effect on the other side. The aim of this study was to study the effects of clear topical ointment, applied on the whole body, on TEWL in jaundiced preterm infants receiving phototherapy and the effect on serum microbilirubin level.

PATIENTS AND METHOD

The evaporation rate (ER; g/m^2h) was measured in 40 premature infants born at less than or equal to 34 weeks of gestation. All infants had a birth weight appropriate for gestational age and received phototherapy for hyperbilirubinemia in the incubators. Premature infants with skin disease, or respiratory distress were excluded from the study. This study was approved by the Ethics Committee of the Faculty of Medicine, Chulalongkorn University. Informed parental consent was obtained in all cases.

Table 1. Study group composition.

	Treatment group (n = 20)	Control group (n = 20)
Sex Male : Female	11:9	11:9
Birthweight (g)		
Mean ± SD	1428.25 ± 223	1459.0 ± 169
Range	1000 – 1680	1100 – 1690
Gestational age (wk)		
Mean ± SD	32.9 ± 2.4	33.3 ± 2.8
Range	(30 – 36)	(31 – 36)
TB_1 (mg/dl)		
Mean ± SD	9.90 ± 2.2	10.08 ± 2.41
Range	(6.2 – 13.8)	(6.7 – 14.9)
TB_2 (mg/dl)		
Mean ± SD	9.5 ± 2.3	9.1 ± 2.1
Range	(6.0 – 14)	(5.3 – 13.8)

TB_1 = serum microbilirubin before phototherapy
TB_2 = serum microbilirubin after phototherapy for 24 hours

The patients were randomly recruited into a treatment and a control group. The treatment group consisted of 20 preterm infants (11 male and 9 female), with a mean gestational age of 32.9 ± 2.4 weeks (Table 1). Their mean birth weight was 1428 ± 223 g. Their mean serum microbilirubin levels before phototherapy was 9.90 ± 2.2 mg/dl (ranged =6.2-13.8). The control group consisted of 20 preterm infants (11 male and 9 female), with a mean gestational age of 33.3 ± 2.8 weeks. They had a mean birth weight of 1459 ± 169 g. Their mean serum microbilirubin levels before phototherapy was 10.08 ± 2.41 mg/dl (range 6.7-14.9).

Measurement

The patients were clothed only with diapers and eyes were covered by a gauze eye pad. The patients were placed in prone position in the incubators. ER was measured by a method based on determination of the water vapor pressure gradient in the air layer close to the skin surface (Tewameter TM 210, Courage & Khazaka, Koln, Germany)(7). ER and skin ambient temperature were measured from the skin of the upper arms, the back and the lower legs as baseline.

The treatment group received with 3.0 ml of clear topical ointment (vaseline: liquid paraffin = 1:1) to the whole body just before phototherapy. The conventional phototherapy equipment was placed above the incubator. ER and skin ambient temperature were measured at the same points before phototherapy, at 30 minutes and 5 hours during phototherapy. During the measurements the infants were mostly asleep and showed little motor activity. To avoid errors due to moisture on the investigator's hands, rubber gloves were worn. Skin condition on the treament group was observed and compared with the control group. Serum microbilirubin was measured before phototherapy and after 24 hours to evaluate the effect of the clear topical ointment on phototherapy. Analysis of variance (ANOVA) on repeated measurement was used to test for statistical significance in ER and univariate analysis of variance was used to test the difference in serum microbilirubin level in both groups.

Table 2. Evaporation rate and ambient skin temperature before and after application of clear topical ointment during phototherapy in non-servocontrol incubators.

	Time			P value	
	Time 0	At 30 min	At 5 h.	At 30 min	At 5 h.
ER					
Treatment group	8.7 ±1.7	7.02 ± 1.3	7.5 ± 1.5	<0.001	0.003
Control group	7.8 ± 1.1	8.4 ± 1.2	8.9 ± 1.6	0.01	<0.001
Tamb					
Treatment group	31.0 ± 1.2	31.7 ± 1.2	32.1 ± 1.3	0.002	<0.001
Control group	31.2 ± 1.1	32.1 ± 0.9	32.1 ± 1.0	<0.001	<0.001

ER = evaporation rate, Tamb = ambient skin temperature

RESULTS

Table 2 shows the ER and ambient skin temperature before and during phototherapy. Before phototherapy, ER in both groups was not significantly different (p=0.06). At 30 minutes and 5 hours during phototherapy, mean ER in the control group increased from 7.8 to 8.4 and 8.9 g/m^{2}h, respectively (p=0.01 and <0.001). Conventional phototherapy in preterm infants in incubators increased ER during phototherapy by 8.0 per cent and 14.5 per cent at 30 minutes and 5 hours, respectively. In the treatment group, after application of clear topical ointment at the onset of phototherapy, the mean ER decreased from 8.7 to 7.0 and 7.5 g/m^{2}h, respectively ($p \leq 0.01$ and 0.003). Clear topical ointment decreased ER in preterm infants during conventional phototherapy in incubators by 19.2 per cent and 13.2 per cent at 30 minutes and 5 hours, respectively.

Mean ambient skin temperature at 30 minutes and 5 hours during phototherapy in the control group increased from 31.2°C to 32.1°C and 32.1°C, respectively ($p < 0.001$ both). In the treatment group, mean ambient skin temperature at 30 minutes and 5 hours during phototherapy also increased from 31.0 to 31.7 and 32.1°C, respectively ($p = 0.002$ and < 0.001). Serum microbilirubin difference of pre and post phototherapy at 24 hours in both groups was not significantly different ($p = 0.38$). None of the patients in both groups had diarrhea or rash during the study period.

DISCUSSION

The effect of phototherapy on ER is still controversial. Oh and Karechi[8] found that the insensible water loss (IWL) was significantly greater in full-term hyperbilirubinemic term infants receiving phototherapy in incubators. The temperature of the incubators' wall also increased. The IWL was measured by calculating the water intake, urine, stool water loss and body weight. ER was not measured directly from the skin. Kjartansson et al measured ER directly from the skin during phototherapy in 10 term and 7 preterm infants and found that ER was not significant even though there was an increase in the incubator wall temperature[9]. In the authors' previous study, it was found that ER was significantly increased during conventional phototherapy in 40 term infants compared with 40 healthy term infants without clinical jaundice[5]. The ambient skin temperature was also increased significantly. In another study, clear topical ointment (vasaline: liquid paraffin = 1:1) applied to half of the body could reduce ER 29 per cent compared to the untreated side[6]. There was no time-dependent variation of ER during the period of study (5 hours) on the untreated side. In that study, it was not known whether application of clear topical ointment on half of the body would have any compensatory effect on the other side. In this study, the authors applied clear topical ointment to the whole body of jaundiced preterm infants receiving conventional phototherapy in incubators. It was found that ER in the premature infants receiving phototherapy increased significantly. The mode of servocontrol of skin temperature in these infants was not used. The ambient skin temperature was also increased significantly in both groups. Bell et al, found that increased ambient temperature above or near the top of the neutral zone in low-birth-weight

infants produced a significant rise in IWL[1]. TEWL increases with various conditions such as in premature infants less than 33 weeks of gestational age [10,11], skin trauma[11], body temperature[1,12], activity and ambient temperature[2]. In this study the ambient skin temperature increased significantly during conventional phototherapy in both groups which might be the cause of increased ER in the infants. Clear topical ointment made from vaseline and liquid paraffin in the ratio of 1:1 is inexpensive and can be used safely, to reduce ER in preterm infants receiving phototherapy. The difference of pre- and post phototherapy serum microbilirubin at 24 hours between the 2 groups was not significant.

In conclusion, conventional phototherapy in premature infants in non-servocontrolled incubators can increase TEWL. Clear topical ointment could decrease TEWL without effect on serum microbilirubin.

ACKNOWLEDGEMENT

The authors wish to thank Dr. Krisana Kaisintu, Head of Research and Development Institute, Government Pharmaceutical Organization for permission to use the Tewameter.

(Received for publication on October 24, 2001)

REFERENCES

1. Maisels MJ. Jaundice. In : Avery GB, Fletcher MA, Mac Donald MG, Eds. Neonatology : pathophysiology and management of the newborn 4th ed. Philadelphia: Lippincott, 1994: 765-819.
2. Wu PYK, Hodgman JE. Insensible water loss in premature infants : changes with post - natal development and non - ionizing radiant energy. Pediatrics 1974; 54: 704-12.
3. Rutter N. The immature skin. Br Med Bull 1988; 44: 957-70.
4. Nopper AJ, Horii KA, Sookdeo-Drost S, Wang TH, Mancini AJ, Lane AT. Topical ointment benefits premature infants. J Pediatr 1996; 128: 660-9.
5. Wananukul S, Praisuwanna P. Transepiderrmal water loss during conventional phototherapy in non-hemolytic hyperbilirubinemia term infants. J Med Assoc Thai 2001; 84 (Suppl 1): S46-S50.
6. Wananukul S, Praisuwanna P, Kesorncam K. Effect of clear topical ointment on transedpidermal water loss in jaundiced preterm infant receiving phototherapy. J Med Assoc Thai 2001; 84: 837-41.
7. Pinnagoda J, Tupker RA, Agner T, Serup J. Guidelines for transepidermal water loss (TEWL) measurement. A report from the standardization group of the European Society of Contact Dermatitis. Contact Dermatitis 1990; 22: 164-78.
8. Oh W, Karecki H. Phototherapy and insensible water loss in newborn infants. Am J Dis Child 1972; 124: 230-2.
9. Kjartansson S, Hammerlund K, Sedin G. Insensible water loss from the skin during phototherapy in term and preterm infants. Acta Paediatr 1992; 81: 764-8.
10. Hammarlund K, Sedin G. Transepidermal water loss in newborn infants III. Relation to gestational age. Acta Paediatr Scan 1979; 68: 795-801
11. Rutter N. The immature skin. Br Med Bull 1998; 44: 957-70.
12. Sedin G, Hammarlund K, Nilsson GE, Stromberg B, Oberg PA. Measurements of transepidermal water loss in newborn infants. Clin Perinatol 1985; 12: 79-99.

การทาสารประกอบน้ำมันลดการสูญเสียน้ำทางผิวหนังในเด็กทารกคลอดก่อนกำหนดที่ได้รับการรักษาด้วยแสงบำบัด

ศิริวรรณ วนานุกูล, พ.บ., ปราโมทย์ ไพรสุวรรณ, พ.บ.**

ทำการวัดผลของการทาสารประกอบน้ำมันต่อการสูญเสียน้ำผ่านผิวหนังในเด็กทารกคลอดก่อนกำหนดที่อายุครรภ์น้อยกว่าหรือเท่ากับ 34 สัปดาห์ จำนวน 40 คน ที่มีภาวะตัวเหลืองต้องได้รับแสงบำบัด โดยวัดทั้งข้างซ้ายและข้างขวาใน 3 ตำแหน่งคือ ที่ต้นแขน หลัง และต้นขาทั้ง 2 ข้าง แบ่งเด็กออกเป็น 2 กลุ่ม วัดก่อนให้แสงบำบัด กลุ่มทดลองทาสารประกอบ 3.0 มล. ที่ลำตัวและแขน ขา ก่อนให้แสงบำบัด กลุ่มควบคุมไม่ได้ทาสารประกอบน้ำมัน แล้ววัดการระเหยของน้ำผ่านผิวหนังและอุณหภูมิที่ 30 นาที และ 5 ชั่วโมงขณะให้แสงบำบัด ผลการศึกษาพบว่าในกลุ่มควบคุมการระเหยของน้ำผ่านผิวหนังเพิ่มขึ้นร้อยละ 8 (P=0.01) และร้อยละ 14.5 (P<0.001) ที่ 30 นาที และ 5 ชั่วโมงขณะให้แสงบำบัด ในขณะที่สารประกอบน้ำมันสามารถลดการระเหยของน้ำผ่านผิวหนังร้อยละ 19.2 (P<0.001) และร้อยละ 13.2 (P=0.003) ที่ 30 นาที และ 5 ชั่วโมง ขณะให้แสงบำบัด โดยที่อุณหภูมิเหนือผิวหนังขณะให้แสงบำบัดเพิ่มขึ้นในทั้ง 2 กลุ่มอย่างมีนัยสำคัญทางสถิติ (P<0.01) ค่าไมโครบิลิรูบินที่เปลี่ยนแปลง 24 ชั่วโมง หลังการให้แสงบำบัดของทั้ง 2 กลุ่มไม่แตกต่างกัน (P=0.38) โดยสรุปการให้แสงบำบัดในเด็กทารกคลอดก่อนกำหนดที่ตัวเหลืองและได้รับแสงบำบัดในตู้อบทำให้อุณหภูมิเหนือผิวหนังเพิ่มขึ้นและการทาสารประกอบน้ำมันสามารถลดการระเหยของน้ำผ่านผิวหนังอย่างมีนัยสำคัญทางสถิติ โดยไม่มีผลต่อการลดลงของระดับไมโครมิลิรูบิน

คำสำคัญ : การสูญเสียน้ำทางผิวหนัง, แสงบำบัด_เด็กคลอดก่อนกำหนด, สารประกอบน้ำมัน

ศิริวรรณ วนานุกูล, ปราโมทย์ ไพรสุวรรณ
จดหมายเหตุทางแพทย์ ฯ 2545; 85: 102-106

* ภาควิชากุมารเวชศาสตร์, คณะแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย, กรุงเทพฯ 10330