Fiberoptic and conventional phototherapy effects on the skin of premature infants

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To evaluate the effects of conventional phototherapy and fiberoptic phototherapy on trans-epidermal water loss in preterm infants with and without skin ointment application, 20 infants were randomly assigned to receive conventional or fiberoptic phototherapy for non-hemolytic hyperbilirubinemia. After conventional phototherapy, there were no significant differences in trans-epidermal water loss between ointment-treated and untreated areas. After fiberoptic phototherapy, trans-epidermal water loss significantly increased from ointment-treated and untreated areas, but the increase was less in treated areas. (J Pediatr 2001;138:438-40)

Hyperbilirubinemia is routinely treated with conventional phototherapy or fiberoptic phototherapy. CPT was reported to increase trans-epidermal water loss in preterm infants[1-4] by altering skin barrier properties, although this effect is disputed.[5] There are no reports of the effect of FPT or ointment application during phototherapy on TEWL. Therefore we compared epidermal barrier function, by means of TEWL measurements, in infants with and without ointment application receiving CPT or FPT.

Methods

Infants ≤3 days of age were eligible for study if they were 31 to 36 weeks of gestational age, did not have non-hemolytic hyperbilirubinemia, were clinically stable, and had no major congenital malformations. After parental consent was obtained, infants were randomly assigned by the sealed envelope technique to receive FPT (Bili-Blanket, Ohmeda) or CPT (Photo-Therapie 800, Drager). Phototherapy was initiated for a total serum bilirubin value of >220 μmol/L and was discontinued when the bilirubin value was ≤170 μmol/L. Infants were unclothed and supine, and their eyes were protected with patches. The FPT blanket covered the infants up to the thorax-abdomen.

A thin coat of tocopherol-acetate ointment (VEA Spray, Hulka) was applied to the left side of the thorax-abdomen. The ointment contained cyclomethicone, a vehicle for the tocopherol-acetate, which evaporated within 30 minutes, without affecting the TEWL measurements.

We measured TEWL with a noninvasive method (Tewameter TM 210, Courage and Khazaka) before and at 30 minutes and 1 and 2 hours after CPT or FPT was initiated. The phototherapy was transiently interrupted to measure TEWL in FPT-treated infants. All measurements were performed on the left and right sides of the abdomen, with the right untreated side used as the control.

CPT	Conventional phototherapy
FPT	Fiberoptic phototherapy
TEWL	Trans-epidermal water loss

In order to better understand the effect of FPT on TEWL, we also evaluated the effect of an FPT blanket that was not turned on in 10 infants. The infants had clinical characteristics similar to those of infants in the study groups.

The infants were in incubators with a thermo-monitoring system to maintain a normal body temperature (36.5°C) at a relative humidity of 60%. The temperatures of incubator ambient air, incubator roof, tympanum, and skin were measured before initiation of and after 120 minutes of FPT or CPT.

Quantitative data are given as means and SEs. TEWL measurements were compared by means of analysis of variance within the groups and by means of Student *t* test for paired data between the groups.

Results

Ten infants were treated with FPT and 10 with CPT (gestational age, 34.3 ± 1.5

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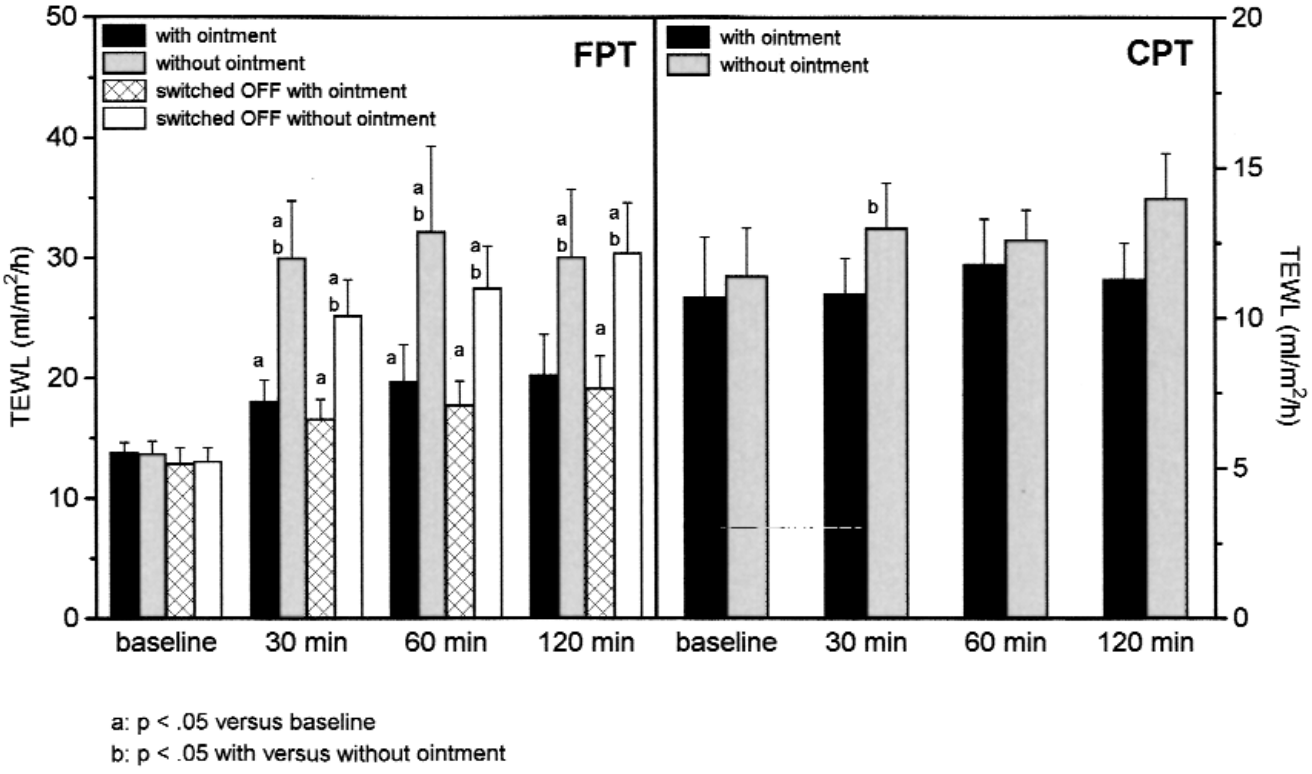

Figure. TEWL changes in ointment-treated and untreated areas during conventional phototherapy *(CPT)*, fiberoptic phototherapy *(FPT)*, and use of FPT blanket that was not turned on. Values are expressed as mean ± SE.

Table. Temperatures of incubator air and roof and of the tympanum and skin in infants treated with fiberoptic or conventional phototherapy

	Temperature (°C)							
	Incubator ambient air		Incubator roof		Tympanum		Skin	
	FPT	CPT	FPT	CPT	FPT	CPT	FPT	CPT
Before start of therapy	32.4 ± 0.2	32.4 ± 0.5	30.2 ± 0.3	30.8 ± 0.4	37.1 ± 0.2	37.2 ± 0.4	36.4 ± 0.3	36.3 ± 0.4
After 120 min	32.8 ± 0.3	32.7 ± 0.6	31.1 ± 0.3	34.1 ± 0.2	37.3 ± 0.3	36.9 ± 0.2	36.9 ± 0.2	36.4 ± 0.5
P value	NS	NS	NS	<.01	NS	NS	NS	NS

Values are expressed as mean ± SE.
FPT, Fiberoptic phototherapy; *CPT,* conventional phototherapy; *NS,* not significant.

wk vs 34.5 ± 0.9 wk; birth weight, 2630 ± 291 g vs 2570 ± 470 g). Heart and respiratory rates were unchanged before or at the end of the study period in both FPT and CPT groups. Phototherapy was initiated at 48 (± 1.6) hours of life in the FPT group and at 51 (± 3.2) hours of life in the CPT group for a similar total bilirubin serum concentration (227 ± 9.6 vs 228 ± 10.2 μmol/L). FPT and CPT lasted 24 (± 2.5) and 25.8 (± 3.4) hours, respectively. Total bilirubin decreased 2.4 μmol/L/h in both groups.

During FPT, TEWL increased in ointment-treated and untreated areas, but the increase was less in the ointment-treated areas (Figure). During CPT, TEWL was unchanged; TEWL was lower in ointment-treated areas, but the difference reached statistical significance only at 30 minutes. TEWL was statistically higher in the FPT group than in the CPT group, in both ointment-treated and untreated areas. The FPT blanket that was not turned on resulted in similar changes in TEWL observed in the FPT group (Figure). There were no significant changes in temperature of the incubator roof, tympanum, and skin in either group, whereas the temperature of the incubator wall increased in the CPT group (Table).

DISCUSSION

Tocopherol-acetate ointment was used because of its antioxidant proper-

ties and to reduce dermatitis in preterm infants (unpublished data). Our study confirmed that in the incubator, the temperature of the roof increases during CPT, whereas the temperature of the ambient air remains unchanged to maintain a stable temperature in the newborn.[6] Like Kjartansson et al,[5] we also found that in thermally stable infants, CPT does not increase TEWL. An unexpected TEWL increase occurred during FPT. We considered the possibility that FPT increased TEWL by affecting skin integrity; however, only one case of skin lesions after the use of FPT has been reported in the literature.[7,8] Moreover, the fiberoptic blanket temperature of commercially available FPT devices does not exceed 23°C.[9] Therefore it is improbable that FPT increases TEWL by affecting skin barrier integrity.

We hypothesized that an FPT blanket applied to infants' skin would reduce TEWL by acting as a mechanical barrier, thereby increasing skin hydration[10] and causing an immediate TEWL increase after removal of the blanket for TEWL measurements. In order to test our hypothesis, we applied an FPT blanket that was not turned on to 10 infants and found that TEWL increased after blanket removal (Figure). Our findings suggest that a TEWL increase is caused by the application of FPT blankets rather than by light irradiation.

Skin ointment significantly reduced the TEWL increase during FPT, whereas this effect was not seen during CPT. The decrease in TEWL with ointment is explained by its effectiveness in enhancing skin barrier function.[11,12] In conclusion, this study confirmed that in thermally stable infants, TEWL is not increased by CPT, whereas it is significantly increased by FPT. Such an increase of TEWL appears to be related to the FPT blanket's barrier effect and TEWL measurement methods rather than to light irradiation.

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