Hydration and pH of cord and dorsal hand in high-risk infants for 7 days of life

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Background 1

1. Function of skin in infants

- Physical barrier as body surface area (BSA): 13% of body weight
- Fluid & electrolytes balance: hydration, insensible water loss
- Barrier function: Acid mantle of the stratum corneum (SC)

  Normal flora

2. Significance of skin and cord care

- Clean and dry for healthy term infants
- Aggressive anti-bacterials in case of increased risks
- What if for high-risk infants?

3. Facts on skin of high-risk infants

- Less developed, less integrated
- Various invasive procedures with excessive stimulation

Background 2

4. Evidence based practice (EBP) in nursing process

- Nursing diagnosis: Impaired skin integrity
  Imbalanced fluid volume
  Risk for infection or injury etc
- Assessment: Dryness Moisture Turgor/Texture
  Thinness Color Vascularity
  - Related to a site for organism invasion: invasive lines, intubation, TPN
  - Related to compromised host defenses
  - Related to increased vulnerability: mat. antibody, normal flora, open wound (cord)

→ Lack of scientific evidences: Hydration level and Defense capacity of SC

Study Purposes

1. To measure the pH, temperature and hydration level of the SC dorsal hand and cord area during 7 days of life in high-risk infants

2. To explore the factors to influence the acid mantle formation of the SC on dorsal hand and cord area during 7 days of life in high-risk infants

Method 1

❖ **Design:** A longitudinal prospective explorative study

❖ **Subjects**

- Sample size calculation: using r = -.310 between pH and temperature

  r = -.760 between pH and postnatal days

  with α=.05 and β=.2 → maybe 11- 84 newborns

- Participants
  - **77 newborns** admitted at NICU of Inha University Hospital, Incheon, Korea, during 2010. 9 ~ 2011. 6.
  - 89 recruited – 12 cord-off within 7 days = 77 newborns)
- Exclusion criteria
  - Out-born infants due to missed early days of life.
  - Infants with congenital diseases, skin problems (i.e. impetigo), hernia at cord area, or umbilical lines due to possible outliers

Method 2

❖ **Data Collection**

- IRB approval with Informed consent from parent (s)
- Time-point for data collection: 1st, 2nd, 3rd, 5th , 7th after birth (5 times)
- Site: Dorsal hand, Cord area
- Variables:
  - pH using skin pH meter (HI 99181, HANNA)
  - Temperature
  - Hydration level using National DM-R2, Japan
  - Medical condtions – gestation, sex, anibiotics, etc

❖ **Data analysis**: In IBM SPSS 19.0,

X^2, Pearson correlation, Generalized Estimating Equations (GEE)

Result 1: Demographics/Clinical Variables

Characteristics	Type	N (%) or M (SD)	
Sex	Male	43 (55.8)	
	Female	34 (44.2)	
Type of delivery	NSD	29 (37.7)	
	C/Section	48 (62.3)	
Preterm birth	No	11 (14.3)	
	Yes	66 (85.7)	
Having problem	No	25 (32.5)	
beyond preterm birth	Yes (cord neck, TTN, MS)	52 (67.5)	
Discharge problem	No	37 (48.1)	
	Yes	40 (51.9)	
Artificial ventilation (day)	No	53 (68.8)	
	Yes	24 (31.2)	Mean = 6.9
Duration of phototherapy (day)	No	6 (7.8)	
	Yes	71 (92.2)	Mean = 7.5
Gestation at birth (week)		33.9 (2.92)	
Weight at birth (gram)		2,214.6 (729.6)	

Result 2: pH, Temperature, Hydration pH Changes for 7 days of life

	Sites	1st day	2nd day	3rd day	5th day	7th day	F (*p*)	Sites	Days	S * D
		Mean (SD)						F (*p*)		
pH	Hand	6.19 (0.37)	5.93 (0.35)	5.74 (.335)	5.61 (.301)	5.48 (0.31)	53.6 4 (<.001)	286.76 (<.001)	103.60 (<.001)	12.27 (<.001)
	Cord	6.67 (0.43)	6.27 (0.35)	5.99 (0.30)	5.78 (0.32)	5.65 (0.30)	109.87 (<.001)			
Temperature (℃)	Hand	27.0 (1.51)	26.7 (1.62)	26.8 (1.61)	26.5 (1.56)	26.5 (1.51)	1.41 (.229)	13.56 (<.001)	1.97 (.099)	1.21 (.307)
	Cord	27.3 (1.39)	26.9 (1.51)	26.9 (1.35)	26.9 (1.61)	26.6 (1.33)	2.40 (.050)			
Hydration (%)	Hand	32.7 (3.07)	33.7 (4.29)	33.3 (3.11)	34.7 (4.23)	33.9 (3.20)	3.29 (.011)	19.56 (<.001)	4.00 (.003)	0.71 (.587)
	Cord	31.6 (3.96)	33.2 (4.58)	32.9 (3.31)	33.5 (3.13)	32.9 (3.11)	2.97 (.020)			

SUMMARY

- pH at birth: 6.19 (H) and 6.67; Both decline to 5.48 (H) and 5.65 (C), though at Hand > at Cord
- Static peripheral hypothermia (27 ℃) even central temperature WNL in both H and C for 7 days
- slightly increased from 32.7 (H) and 31.6 (C) to 34.7 (H) and 33.5 (C); at Hand > Cord

Result 3: Frequency of AM Groups for 7 Days of Life

Sites	AM groups	1st day	2nd day	3rd day	5th day	7th day	χ^2 (*p*)
		Frequency (%)					
Hand	Group 1	1 (1.3)	6 (7.8)	18 (23.4)	28 (36.4)	44 (57.1)	82.63 (<.001)
	Group 2	76 (98.7)	71 (92.2)	59 (76.6)	49 (63.6)	33 (42.9)	
Cord	Group 1	0 (0.0)	0 (0.0)	2 (2.6)	14 (18.2)	27 (35.1)	73.20 (<.001)
	Group 2	77 (100.0)	77 (100.0)	75 (97.4)	63 (81.8)	50 (64.9)	

AM = Acid mantle; Group 1 = Group with acid mantle formation; Group 2 = Group without acid mantle formation.

SUMMARY

- Acid mantle formation at Hand at 7th days: 44 (57.1%)
- Acid mantle formation at Cord at 7th days: 274 (35.1%)
- Acid mantle formation at both Hand and Cord at 7th days: 20 (26.0%)
- Not Acid mantle formation at any site at 7th days: 26 (33.8%)

Result 4: Frequency of AM Groups for 7 Days of Life

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Result 5. Factors relating to AM Formation of Hand at the 7th Day of Life

Characteristics	Type	Group 1 (n=44)	Group 2 (n=33)	χ^2 or F (*p*)
		Frequency (%) or Mean (SD)		
Sex	Male	28 (63.6)	18 (54.5)	2.53 (.112)
	Female	16 (36.4)	15 (45.5)	
Health problem at birth	No	11 (25.0)	14 (42.4)	2.61 (.106)
	Yes	33 (75.0)	19 (57.6)	
Health problem at hospital*	No	1 (2.3)	1 (3.0)	0.04 (1.000)
	Yes	43 (97.7)	32 (97.0)	
Health problem at discharge	No	24 (54.5)	13 (39.4)	1.73 (.188)
	Yes	20 (45.5)	20 (60.6)	
Use of antibiotics	No	15 (34.1)	22 (66.7)	8.02 (.005)
	Yes	29 (65.9)	11 (33.3)	
Cord redness	No	36 (81.8)	28 (84.8)	0.12 (.725)
	Yes	8 (18.2)	5 (15.2)	
Cord discharge	No	42 (95.5)	29 (87.9)	1.51 (.393)
	Yes	2 (4.5)	4 (12.1)	
Cord granuloma	No	44 (100)	31 (93.9)	2.74 (.180)
	Yes	0 (0.0)	2 (6.1)	
Gestational age (week)		34.3 (3.30)	33.5 (2.30)	1.22 (.227)
Birth weight (g)		2,180.5 (749.8)	2,260.0 (710.6)	-0.47 (.639)
Apgar score at 5 minute		8.0 (1.4)	7.6 (1.6)	1.23 (.223)
Environmental humidity		38.4 (21.7)	37.9 (20.2)	0.96 (.924)
Day of cord-off		13.0 (4.1)	12.4 (4.9)	0.50 (.621)

SUMMARY

- Antibiotics for Acid mantle formation

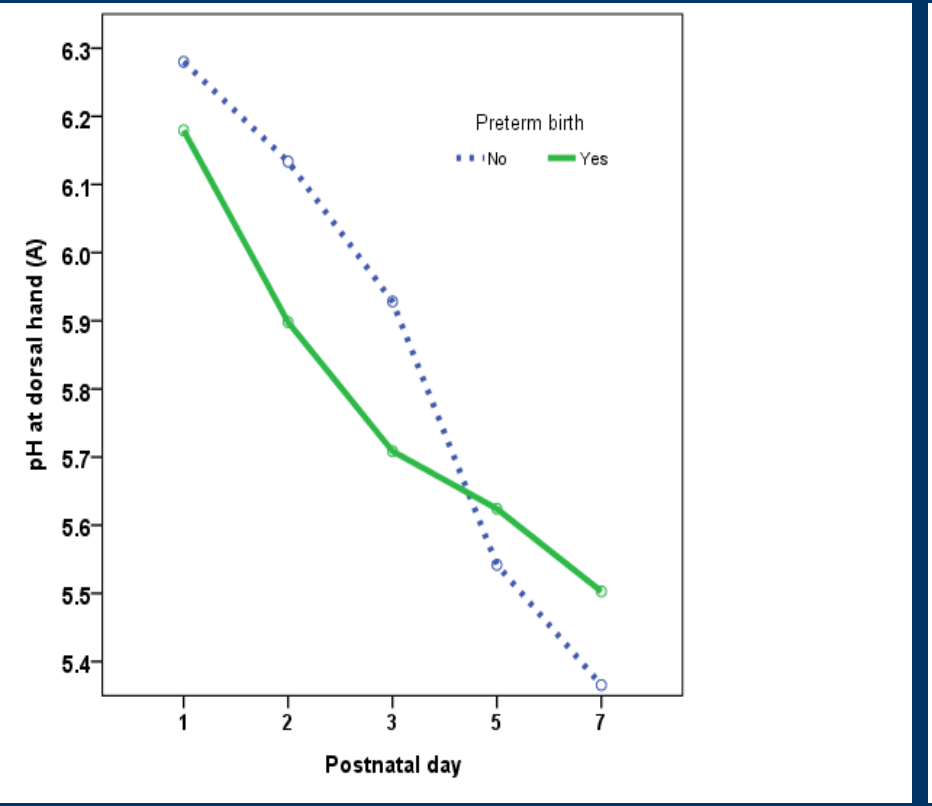
Result 6. Factors relating to AM Formation of Cord at the 7th Day of Life

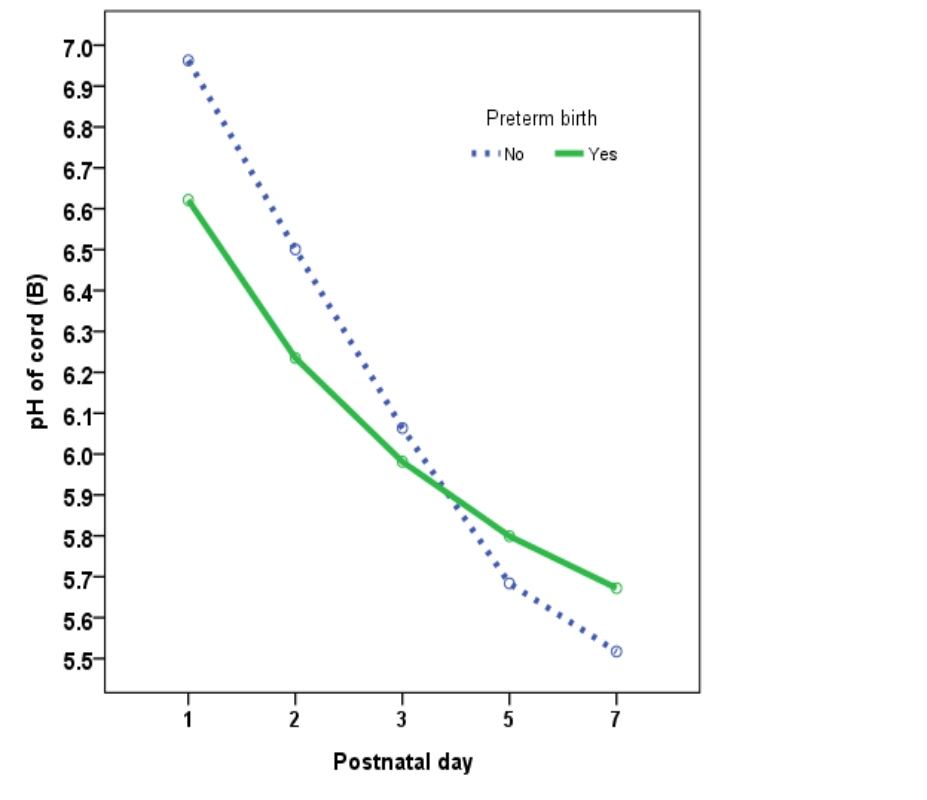
Characteristics	Type	Group 1 (n=44)	Group 2 (n=33)	χ^2 or F (*p*)
		Frequency (%) or Mean (SD)		
Sex	Male	15 (55.6)	28 (56.0)	0.00 (.970)
	Female	12 (44.4)	22 (44.0)	
Health problem at birth	No	8 (29.6)	17 (34.0)	0.15 (.696)
	Yes	19 (70.4)	33 (66.0)	
Health problem at hospital*	No	0 (0.0)	2 (4.0)	1.11 (.539)
	Yes	27 (100.0)	48 (96.0)	
Health problem at discharge	No	16 (59.3)	21 (42.0)	2.09 (.148)
	Yes	11 (40.7)	29 (58.0)	
Use of antibiotics	No	11 (40.7)	26 (52.9)	0.89 (.345)
	Yes	16 (59.3)	24 (48.0)	
Cord redness	No	23 (85.2)	41 (82.0)	0.13 (.722)
	Yes	4 (14.8)	9 (18.0)	
Cord discharge	No	26 (96.3)	45 (90.0)	0.97 (1.000)
	Yes	1 (3.7)	5 (10.0)	
Cord granuloma	No	26 (96.3)	49 (98.0)	0.20 (1.000)
	Yes	1 (3.7)	1 (2.0)	
Gestational age (week)		34.8 (3.3)	33.5 (2.7)	1.85 (.068)
Birth weight (g)		2,434(904.4)	2,095.8 (592.0)	1.75 (.088)
Apgar score at 5 minute		8.1 (1.5)	7.7 (1.5)	1.17 (.247)
Environmental humidity		36.2 (21.8)	39.2 (20.6)	-0.61 (.543)
Day of cord-off		13.4 (4.0)	12.4 (4.7)	0.85 (.397)

SUMMARY

- Antibiotics for Acid mantle formation

Result 7. pH variation by preterm birth for 7 days of life





SUMMARY

- Preterm newborns showed less declined in pH at both sites compared to Full-term newborn with risks (Interaction: F=25.58, p<.001 at hand; F=52.84, p<.001 at cord site).

Conclusions

1. Severe peripheral hypothermia
2. Low hydration level on the SC regardless of high level expected
3. Delayed in Acid mantle formation in preterm newborns

❖ **Implications to practices and Research: EBP in nursing process**

- Nursing diagnosis: Impaired skin integrity
  Imbalanced fluid volume
  Risk for infection or injury etc
- Assessment: Dryness, Moisture
  Color, Vascularity
  pH for Acid mantle

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