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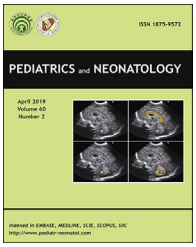

Original Article

Association between rooming-in policy and neonatal hyperbilirubinemia

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Key Words
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Background: The practices promoted by the Baby-friendly Hospital Initiative have become a part of current mainstream postpartum infant care. Rooming-in to facilitate skin-to-skin contact and breastfeeding is a major component of this initiative. However, whether rooming-in is associated with admission for neonatal hyperbilirubinemia has seldom been reported. The aim of this study was to evaluate the association between rooming-in and neonatal hyperbilirubinemia.

Methods: This was a retrospective cohort study. Term neonates were consecutively enrolled from the nursery of a medical center from January 2011 to December 2013. During the study period, rooming-in care was strongly encouraged according to the World Health Organization guidelines, if the parents agreed. The endpoint was defined as admission for phototherapy. Risk of neonatal hyperbilirubinemia in rooming-in neonates was calculated. Potential confounding factors, including exclusive breastfeeding, potential ABO incompatibility, Glucose-6-Phosphate Dehydrogenase (G6PD) deficiency, and body weight loss (BWL), were adjusted by multiple logistic regression models.

Results: Totally, 3341 infants were enrolled in this study after excluding 40 infants admitted for other reasons. The rooming-in rate increased yearly during the study period. However, the rate of neonatal hyperbilirubinemia also increased simultaneously. The odds ratio (OR) of neonatal hyperbilirubinemia in the rooming-in group was 7.04 (95% CI, 4.41～11.24). The rooming-in group demonstrated a higher percentage of exclusive breastfeeding and BWL >10% at 3 days of age. After adjusting for potential confounding factors, rooming-in was still a significant risk factor for neonatal hyperbilirubinemia (OR: 8.48; 95% CI: 5.04～14.25).

Conclusions: The practice of rooming-in is now part of the mainstream postpartum newborn care. However, the increased incidence of neonatal hyperbilirubinemia is a potential side effect of which healthcare providers should be aware. Further research is needed to confirm the role of rooming-in in neonatal hyperbilirubinemia.

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1. Introduction

Since the World Health Organization (WHO) launched the Baby-friendly Hospital Initiative (BFHI) in 1991,[1] the practice of BFHI has become a mainstream concept in postpartum infant care. In 2010, it was estimated there were 21,328 hospital or birthing centers designated as a Baby-friendly Hospital (BFH) in 160 countries around the world.[2,3]

Among the "Ten Steps" of the BFHI, the policy of rooming-in plays a very important role as it is intended to promote breastfeeding, which is the main purpose of the BFHI.[4–6] The rooming-in policy has various advantages which include promoting and supporting breastfeeding, facilitating skin-to-skin contact, and limiting the number of infants infected in nurseries due to contact with other infants, doctors, and nurses.[7,8]

However, while the BFHI was promoted to enhance breastfeeding and rooming-in in Taiwan, where it became the mainstream approach in postnatal care, the incidence of neonatal hyperbilirubinemia also increased simultaneously.[9] This phenomenon might be attributed to the increased breastfeeding rate, but whether rooming-in is an independent risk factor for neonatal hyperbilirubinemia has seldom been studied.[10–12] As a result, we conducted this retrospective hospital based cohort study to elucidate the association between the rooming-in policy and neonatal hyperbilirubinemia.

2. Material and methods

This was a hospital-based retrospective cohort study. Medical records of full-term newborn infants born between January 1, 2011 and December 31, 2013, who were admitted to the well-baby nursery of Taichung Veterans General Hospital, were reviewed retrospectively.

During the study period, rooming-in care was encouraged according to the WHO guidelines: each newborn stayed in the mother's room for the entire day after birth if the parents agreed.[1] Exclusive breastfeeding was defined as infants who were breastfed only, without formula supplementation. The feeding policy in our nursery was mainly under the principle of the Baby-friendly Hospital Initiative. Unless under special circumstances or the parents' request, infants would not be fed with anything other than breast milk. Body weight loss (BWL) at 3 days of age was defined as [(birth body weight− 3-day-old body weight)/(birth body weight x 100%)]. Factors which might be associated with neonatal hyperbilirubinemia were also collected, such as Glucose-6-Phosphate Dehydrogenase (G6PD) deficiency, and ABO blood types were also collected. Because the Coombs test was not available for most of the infants, potential ABO incompatibility was defined as follows: a mother's blood type was O and the infant's blood type was A or B. We checked every baby's transcutaneous bilirubin level (TcB) every morning. If TcB >11 mg/dl, we checked total serum bilirubin from heel stick to evaluate if the baby needed phototherapy according to 2004 American Academy of Pediatrics clinical practice guideline on the management of hyperbilirubinemia in the newborn infant.[13] The study endpoint was defined as admission for phototherapy. The study protocol was approved by Taichung Veterans General Hospital's Institutional Review Board, which waived the requirement for obtaining informed consent.

The demographic data were compared by Mann—Whitney U tests and chi-square tests. Each odds ratio and 95% confidence intervals for phototherapy of rooming-in and other factors were calculated first. Then possible confounding factors including exclusive breastfeeding, potential ABO incompatibility, G6PD deficiency, and BWL were adjusted in the multiple logistic regression models. Then stratified analysis was further performed to clarify the interaction between rooming-in, exclusive breast feeding, and body weight loss. The statistical analyses were performed using commercially available computer software programs SAS 9.4 for Windows (SAS Institute, Inc., Cary, NC, USA).

3. Results

During the study period, after excluding 40 infants who were transferred to the sick baby room or the neonatal intensive care unit due to diseases other than hyperbilirubinemia, the medical records of 3341 term neonates from our nursery were reviewed. The neonates were divided into rooming-in and non-rooming-in groups. Demographic data are listed in Table 1. Among them, 786 newborn infants (23.5%) were roomed-in within the study period. The infants of room-in group had higher portion of natural spontaneous delivery, potential ABO incompatibility, exclusive breast feeding, and body weight loss >7%. Although the birth weight and gestational age reached statistical significance, the difference might not be clinically significant (71 gm and 2.1 days).

The rooming-in ratio progressively increased following the promotion of the BFHI, which was paralleled by a rise in the rate of neonatal hyperbilirubinemia (Fig. 1A). Babies of rooming-in care contributed more to the raised admission rate than those not rooming-in (Fig. 1B). The rates of neonatal hyperbilirubinemia group were higher among babies of rooming-in care, exclusive breastfeeding, G6PD deficiency, and potential ABO incompatibility in the univariate analysis. Body weight loss of 7% or 10% did not significantly increase the risk of hyperbilirubinemia (Table 2).

We further analyzed the independent effect of rooming-in by multiple logistic regression. The crude odds ratio of neonatal hyperbilirubinemia in the rooming-in group was

Table 1 The demographic data of the study population.

	Rooming-in (n = 786)	Non-rooming-in (n = 2555)
Gestational age (weeks)*	38.9 ± 1.2	38.6 ± 1.4
Birth weight (g)*	3161.7 ± 377.8	3090.7 ± 414.5
Gender		
Male	406 (51.7%)	1368 (53.5%)
Female	380 (48.4%)	1187 (46.5%)
NSD*	604 (76.8%)	1544 (60.4%)
G6PD deficiency	12 (1.5%)	49 (1.9%)
Potential ABO incompatibility[a,]*	369 (47.1%)	1082 (42.4%)
Exclusive breast feeding*	576 (73.3%)	741 (29.0%)
Body weight loss >7%*	537 (68.3%)	1200 (47.0%)
Body weight loss >10%*	42 (5.3%)	79 (3.1%)

Values = Mean ± SD.
NSD: natural spontaneous delivery.
*$p < 0.05$.
[a] Missing data (N = 4).

7.04 (95% confidence interval, 4.41～11.24) in model 0. After adjusting for exclusive breastfeeding and BWL percentages exceeding 10% at 3 days of age in model 1, the odds ratio of neonatal hyperbilirubinemia in rooming-in neonates became 8.55 (95% confidence interval, 5.10～14.32). We further adjusted for all possible confounding factors including exclusive breastfeeding, BWL of >10% at 3 days of age, G6PD deficiency, potential ABO incompatibility, and NSD in the saturated model 2, and the odds ratio of neonatal hyperbilirubinemia among rooming-in neonates was still robustly 8.48 (95% confidence interval, 5.04～14.25) (Table 3).

Because exclusive breastfeeding is a potential confounder and effect modifier, we further conducted a stratified analysis for exclusive breastfeeding and rooming-in. For infants who were exclusively breastfed, the odds ratio of rooming-in for neonatal hyperbilirubinemia was 9.81 (95% confidence interval: 3.83～25.17), and in non-breastfeeding infants the odds ratio of neonatal hyperbilirubinemia in rooming-in neonates was 8.10 (95% confidence interval: 4.31～15.24). The common odds ratio was 8.95 (95% confidence interval: 5.07～15.82). Because the homogeneity test was non-significant, rooming-in might be a risk factor for admission due to hyperbilirubinemia that is independent of breastfeeding (Table 4). When babies were stratified according to rooming-in care or not, the odds ratio for neonatal hyperbilirubinemia was 0.67 (95% confidence interval: 0.38～1.20) in the rooming-in group and 0.55 (95% confidence interval: 0.21～1.47) in the non-rooming-in group. The common odds ratio was 0.63 (95% confidence interval: 0.38～1.04). The homogeneity test was not significant. The effects were not different between strata. The risk of exclusive breast feeding for hyperbilirubinemia was independent of rooming-in (Table 5). When babies were stratified according to body weight loss of more than 7% or not, the odds ratio for neonatal hyperbilirubinemia was 6.69 (95% confidence interval: 3.44～13.03) in body weight loss >7% group and 8.23 (95% confidence interval: 4.18～16.20) in the non-rooming-in group. The common odds ratio was 7.28 (95% confidence interval: 4.48～11.81). The homogeneity test was not significant. The effects were not different between strata.

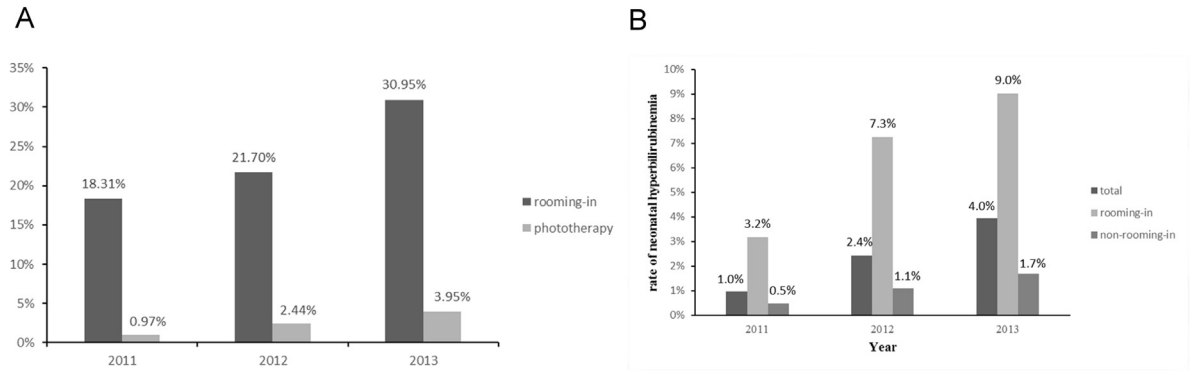

Figure 1 A. As the rate of rooming-in increased, the incidence of neonatal hyperbilirubinemia increased from 2011 to 2013. B. Annular rate of neonatal hyperbilirubinemia among babies with and without rooming-in care.

Table 2 Proportion and odds ratio for hyperbilirubinemia of rooming-in, exclusive breastfeeding, body weight loss, G6PD deficiency, potential ABO incompatibility, and delivery type.

	Hyperbilirubinemia (+)	Hyperbilirubinemia (−)	OR (95% CI)
	n = 82 (2.5%)	n = 3259 (97.6%)	
Rooming-in*	55/82 (67.1%)	731/3259 (22.4%)	7.1 (4.41−11.25)
Exclusive breast feeding*	41/82 (50.0%)	1276/3259 (39.2%)	1.6 (1.00−2.41)
Body weight loss >7%	46/82 (56.1%)	1691/3259 (51.9%)	1.2 (0.76−1.84)
Body weight loss >10%	5/82 (6.1%)	116/3259 (3.6%)	1.8 (0.70−4.43)
G6PD deficiency*	5/82 (6.1%)	56/3259 (1.7%)	3.7 (1.45−9.53)
Potential ABO incompatibility*	49/82 (59.8%)	1402/3255 (43.1%)[a]	2.0 (1.26−3.07)
NSD	56/82 (68.3%)	2092/3259 (64.2%)	1.2 (0.75−1.92)

*$p < 0.05$.
CI: confidence interval, G6PD: Glucose-6-Phosphate Dehydrogenase, NSD: natural spontaneous delivery, OR: odds ratio.
[a] missing data (n = 4).

Table 3 Multiple logistic regression models for risk of neonatal hyperbilirubinemia between rooming-in and non-rooming-in babies.

	Odds ratio	95% CI
Model 0	7.04	(4.41 ~ 11.24)
Model 1	8.55	(5.10 ~ 14.32)
Model 2	8.48	(5.04 ~ 14.25)

Model 0: Univariate logistic regression.
Model 1: Adjusted for exclusive breastfeeding and body weight loss >10%.
Model 2: Adjusted for exclusive breastfeeding, body weight loss >10%, G6PD deficiency, potential ABO incompatibility and NSD.
CI: confidence internal.

The risk of rooming-in for hyperbilirubinemia was independent of body weight loss (Table 6).

4. Discussion

Since the implementation and promotion of rooming-in in the period from 2011 to 2013, the incidence of admission for phototherapy because of neonatal hyperbilirubinemia increased. Although exclusive breastfeeding and greater body weight loss partially explained the increased risk, rooming-in was still a significant independent risk factor for neonatal hyperbilirubinemia.

Rooming-in is a method of caring for newborns which involves the infant staying with the mother in the same room, with the mother taking care of her baby herself. Rooming-in provides numerous advantages that include facilitating skin-to-skin contact, reducing the number of infants infected by contact with other infants, doctors, and nurses, and, most importantly, facilitating breastfeeding. Since the 1940s, in contrast to the conventional separation of the mother and infant with isolated baby nurseries in hospitals, this "new" concept was proposed to facilitate breastfeeding and maternal-infant bonding.[14−16] In 1991, the WHO and United Nations Children's Fund launched the Baby-friendly Hospital Initiative. Rooming-in is one of the major components of this initiative.[17] A number of major professional organizations such as the American Academy of Pediatrics and the American College of Obstetricians and Gynecologists have also endorsed rooming-in policy for neonates after birth.[18−20]

Breastfed babies have a higher risk of neonatal hyperbilirubinemia compared with formula-fed babies because there is a greater likelihood of insufficient feeding, greater body weight loss, or decreased calorie intake.[21−24] The rooming-in policy facilitates breastfeeding. Thus, the rate of neonatal hyperbilirubinemia may increase in parallel with the increased adoption of rooming-in. Previous studies concluded that rooming-in was not an independent risk factor for neonatal hyperbilirubinemia among healthy, non-premature newborns.[10−12] However, those studies were conducted over 20 years ago, so the newborn feeding or care policies and criteria for phototherapy might be

Table 4 Risk of hyperbilirubinemia for rooming-in stratified by exclusive breastfeeding.

			Odds ratio (95% CI)[a]	Common odds ratio (95% CI)[b]
EBF(+)	Rooming-in (+)	36/576 (6.3%)	9.81 (3.83−25.17)	8.95 (5.07−15.82)
	Rooming-in (−)	5/741 (0.7%)		
EBF(−)	Rooming-in (+)	19/210 (9.1%)	8.10 (4.31−15.24)	
	Rooming-in (−)	22/1814 (1.2%)		

CI: confidence interval; EBF: exclusive breastfeeding.
[a] Breslow-Day odds ratio homogeneity test, p = 0.72.
[b] Common odds ratio was estimated by the Mantel-Haenszel common odds ratio estimation under the common odds ratio of 1.000 assumption.

Table 5 Risk of hyperbilirubinemia for exclusive breastfeeding stratified by rooming-in.

		Odds ratio (95% CI)[a]	Common odds ratio (95% CI)[b]
Rooming-in (+)	EBF(+) 36/576 (6.3%)	0.67 (0.38–1.20)	0.63 (0.38–1.04)
	EBF(−) 19/210 (9.1%)		
Rooming-in (−)	EBF(+) 5/741 (0.7%)	0.55 (0.21–1.47)	
	EBF(−) 22/1814 (1.2%)		

CI: confidence interval; EBF: exclusive breastfeeding.
[a] Breslow-Day odds ratio homogeneity test, p = 0.74.
[b] Common odds ratio was estimated by the Mantel-Haenszel common odds ratio estimation under the common odds ratio of 1.000 assumption.

Table 6 Risk of hyperbilirubinemia for rooming-in stratified by body weight loss.

			Odds ratio (95% CI)[a]	Common odds ratio (95% CI)[b]
BWL>7%	Rooming-in (+)	34/537 (6.3%)	6.69 (3.44–13.03)	7.28 (4.48–11.81)
	Rooming-in (−)	12/1200 (1.0%)		
BWL≤7%	Rooming-in (+)	21/249 (8.4%)	8.23 (4.18–16.20)	
	Rooming-in (−)	15/1355 (1.1%)		

CI: confidence interval; BWL: body weight loss.
[a] Breslow-Day odds ratio homogeneity test, p = 0.67.
[b] Common odds ratio was estimated by the Mantel-Haenszel common odds ratio estimation under the common odds ratio of 1.000 assumption.

different. In this study, however, after adjustment for potential confounding factors in the multiple logistic regression models, rooming-in was still an independent risk factor for neonatal hyperbilirubinemia. This result is therefore inconsistent with the findings of previous reports. This inconsistency is possibly due to the larger sample size and longer study period in our study compared with those of the three aforementioned studies (3341 healthy term infants versus 903 vs. 204 vs. 414; 3 years versus 6 months vs. 6 months vs. 6 months). By stratified analysis in Table 5, exclusive breast feeding was not a significant risk factor for neonatal hyperbilirubinemia in either rooming-in or non-rooming-in strata. The homogeneity test was not significant, which might mean that the effect of breast feeding was independent to rooming-in. This was a single institutional study, so the results might not be applicable in other hospitals and other countries. However, our study demonstrated that the rooming-in policy could still lead to an adverse health effect even though it is currently a widely accepted and recommended approach to neonatal care. The infants in the rooming-in group obviously had a higher breastfeeding rate compared with the non-rooming-in group. Also, a greater proportion of the rooming-in infants exhibited body weight loss compared with non-rooming-in infants. Nevertheless, in the multiple logistic regression model and stratified analysis, breastfeeding and body weight loss could not fully explain the increased hyperbilirubinemia rate. Body weight loss may be a late index of inadequate feeding. Most babies receiving rooming-in are nipple feeding, so it is difficult to accurately estimate the amount of breast milk intake. Neonatal hyperbilirubinemia may happen before body weight loss due to increased enterohepatic circulation. Nevertheless, we did not determine which component of the practice of rooming-in increased the prevalence of neonatal hyperbilirubinemia in this retrospective study because of the limited information available from charts. Different duration of hospital stay due to delivery type could influence the diagnosis of neonatal hyperbilirubinemia. According to the reimbursement rule of Taiwan National Health Insurance, the length of stay is 3 days for NSD and 5 days for CS. The variance among length of stay was almost completely explained by the delivery type. Therefore, we did not collect the data of admission duration at data collection step. The median age of diagnosis was not collected either, so we cannot provide further analysis on this which is one limitation of this study. The real cause of increased hyperbilirubinemia rate should be further studied in larger-scale studies with prospective design. Parity could be a factor related to maternal experiences of breast feeding and room-in care. However, the data were not analyzed in this study, which is another limitation of this study.

The practice of rooming-in is now part of the mainstream postpartum newborn care. However, the increased incidence of neonatal hyperbilirubinemia is a potential side-effect of which healthcare providers should be aware. Further research is needed to confirm the role of rooming-in in neonatal hyperbilirubinemia.

Conflict of interest

The authors have no conflicts of interest relevant to this article.

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