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*Original Article*

# Kangaroo mother care could significantly reduce the duration of phototherapy for babies with jaundice

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**Abstract:** Objective: Kangaroo mother care (KMC) was reported to be correlated with the time of phototherapy for babies with neonatal jaundice in the previous studies. The purpose of this study was to verify the effectiveness of KMC on phototherapy for neonatal jaundice. Methods: 216 newborn babies with neonatal jaundice were collected in this study and randomly divided into KMC group and control group. 112 babies in KMC group were received indirect KMC from their parent every day until the end of phototherapy, while the 104 babies in control were received conventional care. The time of phototherapy for neonatal jaundice was used to evaluate the influence of KMC. Results: In this study, we proved that the type of jaundice could significantly influence onset of jaundice, peak bilirubin and time of phototherapy ($P < 0.05$ for all). Besides, babies with jaundice received KMC recovered early from jaundice, compared with control group ($P = 0.000$). In addition, the gestational age was significantly correlated with peak bilirubin ($P = 0.000$). Conclusion: The type of jaundice and KMC can influence the effectiveness of phototherapy for infants with neonatal jaundice. KMC could significantly reduce the duration of phototherapy for babies with jaundice, which might be helpful for the care of neonatal jaundice.

**Keywords:** KMC, phototherapy, neonatal jaundice, preterm, full term

## Introduction

Neonatal jaundice was a common condition which affected newborn babies. The skin and sclera (white of the eyes) of infants with jaundice turned yellow, due to the high level of bilirubin in the skin and mucous membranes [1]. Approximately 60% of term and 80% preterm newborn babies developed jaundice at the first week of age and about 10% of breastfed babies are still jaundiced at 1 month of age [2, 3]. For most babies with jaundice, the early jaundice was harmless. However, two thirds of neonates developed clinical jaundice requiring evaluation and management. There were no complications occurring in a large majority of neonatal jaundice cases, but acute bilirubin encephalopathy and kernicterus did occure in a minority [4].

The conventional treatment for neonatal jaundice was phototherapy. However, photother-apy was reported to be associated with various side effects in the previous studies [5]. Aspberqs et al. had reported that neonatal phototherapy was a risk factor for childhood asthma [6, 7]. In the study of LaRusso et al., phototherapy was reported to induce purpuric eruption in newborn babies [8]. Phototherapy was also proved to lead to hypocalcemia in the research of Sethin et al. [9]. Therefore, a novel pathway which would help shorten the duration of phototherapy was useful for neonatal jaundice. It had been reported that kangaroo mother care (KMC) might reduce the duration of phototherapy for neonatal jaundice [10, 11]. KMC was prolonged skin-to-skin (STS) contact between mothers and infants [12]. Intermittent KMC was keeping contact with babies for short periods once or a few times per day and continuing for a variable number of days [13]. In addition, intermittent KMC was usually employed in high-tech neonatal intensive care units.

In this study, we aimed to detected the effectiveness of intermittent KMC on phototherapy for newborn babies with neonatal jaundice. 216 infants with jaundice were collected in this study and randomly divided into KMC group (babies in this group received intermittent KMC)

and control group (without KMC). Moreover, the time of phototherapy was used to evaluate the effectiveness of KMC.

## Materials and methods

### *Study populations and general parameters*

216 newborns were collected in this study in the neonatal intensive care unit of Qilu Hospital of Shandong University from January 2010 to December 2014. The gestational age of the infants ranged from 35 weeks to 40 weeks and their birth weight was from 2,000 to 3,750 gm. These participants were randomly divided into two groups: KMC group with 112 infants and control group with 104 newborns. The two groups were accepted conventional therapy and the parents of the newborns in KMC group could held their babies intermittently every day until recovery. This study accorded with the rule of Research Ethics Committee of Qilu Hospital of Shandong University and written informed consent was obtained from the parents of all the infants.

### *Screening standard*

The newborns collected in this study were conform with the following condition [10]: 1) jaundice occurred at 48-72 hours of age; 2) the peak of serum bilirubin appeared at day 3-5 of age; 3) the rate of rise of bilirubin was lower than 5 mg/dL/day; 4) the level of conjugated bilirubin was less than 2 mg/dL at any time.

The infants who fit any of the following conditions would not be collected in this study: infants who were born with small gestational age or extremely low birth weight; congenital malformation; babies carrying with high risk or known cause for hyper-bilirubinemia, such as ABO and Rh incompatibility; perinatal asphyxia; neonatal infections; cephalhematoma or signifcant bruises; breastmilk jaundice; late onset of clinical jaundice (5-10 days of age); babies with peak serum bilirubin level appear at day 15; those with rising rate of bilirubin over 1-2 mg/dL/day. Besides, infants who revealed symptoms of jaundice in the first 24 h of born or prolonged jaundice persisting beyond the third week of life and those with hyperbilirubin level needing exchange transfusion according to the American Academy of Pediatrics' guidelines [14] did not enroll in this study. Moreover, we excluded infants with neonatal jaundice caused by mothers, such as multiple gestation, diabetes mellitus, hypertension or synthetic oxytocin used during labor.

### *Methods*

In this study, we investigated two types of jaundice: breastfeeding jaundice and physiological jaundice. The newborns participated in the present study were diagnosed according to the American Academy of Pediatrics' guidelines [14].

The weight of the participators were measured through a electronic scale (Laica Model bf 2051) by the same nurse. The blood specimens were collected from each infant and were used for detection of total bilirubin and direct bilirubin, whole blood cell count and classification, the identification of blood types (ABO and Rh), Coomb's experiment, G6PD and smear for blood cell morphology.

When the level of bilirubin reached the criteria for phototherapy, the infants were put naked in a incubator with eyes and genitalia covered. The phototherapy could be stopped when the blood bilirubin began to fall from the peak value, or the total serum bilirubin (TSB) level was no less than 18 mg/dL or the serum bilirubin level fell below 13 mg/dl. None of the participators did not need phototherapy again.

The operating procedures of phototherapy were according to American Academy of Pediatrics' guidelines. During the phototherapy, the babies were naked except for eyes and genitalia. The babies were turned every 2 hours and the space between the incubator and the lamp cover was 7 cm to prevent overheating. Neonate bilirubin phototherapy equipment YG-I and XHZ (DAVID, Ningbo, China) were used in this study and the used hours of the light were less than 100 h which ensured the effectiveness of the therapy. Blue-green spectrum (wave lengths of approximately 430-490 nm) were used for therapy. The irradiance was 10 $\mu W/cm^2/nm$ in this study. A radiometer specified for the equipment were used for measuring and therapy protocols were followed with the criteria recommended by American Academy of Pediatrics' guidelines.

The babies in the KMC group were accepted phototherapy intermittently as previously de-

**Table 1.** Statistical differences between KMC group and control group

| Variable | KMC group (n, %) | Control group (n, %) | $x^2$ | *P* |
|---|---|---|---|---|
| Mode of delivery | | | 0.543 | 0.461 |
| Vaginal Delivery (VD) | 68 (60.71) | 58 (55.77) | | |
| Cesarean Section (CS) | 44 (39.29) | 46 (44.23) | | |
| Gender | | | 0.010 | 0.919 |
| Boy | 60 (53.57) | 55 (52.88) | | |
| Girl | 52 (46.43) | 49 (47.12) | | |
| Term | | | 0.161 | 0.688 |
| Preterm | 74 (66.07) | 66 (63.46) | | |
| Full term | 38 (33.93) | 38 (36.54) | | |
| Cause of jaundice | | | 0.613 | 0.434 |
| Physiological | 89 (79.46) | 78 (75.00) | | |
| Breastfeeding-associated jaundice | 23 (20.54) | 26 (25.00) | | |

**Table 2.** Comparative study between KMC group and control group

| Factors | KMC group (mean ± SD) | Control group (mean ± SD) | *P* |
|---|---|---|---|
| Birth weight (gm) | 2692.19 ± 501.32 | 2746 ± 497.29 | 0.429 |
| Onset of clinical jaundice (hours) | 71.11 ± 15.79 | 72.64 ± 16.84 | 0.490 |
| Peak bilirubin (mg/dL) | 14.79 ± 1.91 | 14.91 ± 1.91 | 0.649 |
| Time of photo therapy (hours) | 67.04 ± 20.58 | 97.74 ± 41.08 | 0.000 |

scribed and their parents carried on KMC for them following the nurses' introduction. KMC care were carried 3 time daily and 7 days a week until the end of the therapy. Parents contacted with babies skin-to-skin for at least one hour every time and the babies only worn only a diaper and a cap. The infants in the control group were accepted the conventional care and phototherapy. The duration of phototherapy was used to measure the effectiveness of KMC.

*Statistic analysis*

SPSS 18.0 software was performed for data analysis and the results were shown as mean ± S.D. or %. The correlation of clinical characteristics between KMC group and control group was analyzed by Chi-square analysis. Student T test was used to analyze the significant difference of associative factors in test group and control group. $P < 0.05$ was considered as significant.

## Results

*The characteristics of infants in this study*

There were 112 newborns with neonatal jaundice were collected in KMC group in this study and 104 babies with jaundice were acted as control. The average birth weight of the babies in KMC group was 2692.19 ± 501.32 gm, ranged from 1950-3800 gm, while that in the control group was 2746 ± 497.29 gm, ranged from 2000-3874 gm. The characteristics of the newborns were listed in **Table 1**. From the table, we found that there were no significantly difference between the two groups on mode of delivery, gender, gestational age and cause of jaundice ($P > 0.05$ for all).

*Comparative study between KMC group and control group*

The time of phototherapy was used to evaluate the effect of KMC on neonatal jaundice and the results were shown in **Table 2**. The present results indicated that KMC could significantly shorten the duration of required phototherapy ($P = 0.000$). The average phototherapy time of babies in KMC group was 67.04 ± 20.58 hours, while that in the control group was 97.74 ± 41.08 hours.

*Comparative analysis between pathological jaundice and breastfeeding-associated jaundice*

In the present study, we analyzed the correlated factors between pathological jaundice and breastfeeding-associated jaundice and the results were shown in **Table 3**. From the table, we found that the type of jaundice was significantly associated with onset of jaundice ($P = 0.000$), peak bilirubin ($P = 0.002$) and the time of phototherapy ($P = 0.001$). However, the birth weight was not obviously different between the two groups ($P > 0.05$).

*Correlative analysis between preterm and full term group*

We analyze the correlation between preterm and full term group and the results were shown

**Table 3.** Comparative analysis between physiological and breastfeeding-associated jaundice

| Factors | physiological group (mean ± SD) | Breastfeeding-associated group (mean ± SD) | *P* |
|---|---|---|---|
| Birth weight (gm) | 2730.16 ± 5606.37 | 2678.30 ± 476.26 | 0.521 |
| Onset of clinical jaundice (hours) | 69.25 ± 14.10 | 80.40 ± 19.84 | 0.000 |
| Peak bilirubin (mg/dL) | 14.63 ± 1.86 | 15.58 ± 1.91 | 0.002 |
| Time of photo therapy (hours) | 77.58 ± 32.18 | 95.90 ± 42.37 | 0.001 |

**Table 4.** Comparative analysis between preterm and full term group

| Factors | Preterm group (mean ± SD) | Full term group (mean ± SD) | *P* |
|---|---|---|---|
| Birth weight (gm) | 2727.50 ± 490.47 | 2700.95 ± 517.07 | 0.710 |
| Onset of clinical jaundice (hours) | 72.01 ± 16.54 | 70.91 ± 15.82 | 0.832 |
| Peak bilirubin (mg/dL) | 15.24 ± 1.69 | 14.14 ± 2.08 | 0.000 |
| Time of photo therapy (hours) | 82.76 ± 35.13 | 80.08 ± 36.47 | 0.597 |

in **Table 4**. The present results suggested that the gestational age of newborns was associated with peak bilirubin ($P = 0.000$). Babies born with full term showed low peak bilirubin than preterm (15.33 ± 1.70 vs 13.97 ± 1.97).

## Discussion

Neonatal jaundice happened when the bilirubin level in blood increased. Bilirubin was created from the normal breakdown process of red blood cells and exited the body through the urine and stool with the help of liver [15]. Many of babies with jaundice did not have problems or need treatment. However, the high level of bilirubin in blood might cause diseases [16]. In the study of Maria et al., neonatal jaundice was reported to be associated with a great in childhood type 1 diabetes [17]. Akinpelu OV et al. had reportted that hyperbilirubinemia resulted in abnormal hearing assessment in up to 83.3% of term newborns and treatment of hyperbilirubinemia led to a considerable decrease in the incidence of hearing loss [18]. Similar results were obtained by Corujo-Santana et al., they indicated that the children suffering hyperbilirubinemia at birth were more likely diagnosed with sensorneural hearing loss than the general population [19]. Thus, it was important to treat and abate neonatal jaundice quickly.

Phototherapy was accepted as the major treatment for neonatal jaundice. However, this treatment also put the babies at risk of important complication, such as retinal injury, dehydration, diarrhea and bronze baby syndrome [20]. Therefore, a safety pathway which could help reduce the time of phototherapy might be wildly used in clinical practices. In the study of Nashwa M. et al., KMC was reported to be useful for reducing duration of phototherapy for neonatal jaundice [10]. In the present study, the effectiveness of KMC on phototherapy of neonatal jaundice was verified. The results demonstrated that KMC could significantly help the babies recover early from jaundice during phototherapy. KMC was an evidence-based approach to reduce mortality and morbidity in preterm infants which was first developed in Bogota Colombia [12]. KMC was useful for neonatal care, in a meta-analysis, KMC was reported to significantly reduce preterm mortality and improve other outcomes such as severe infection/sepsis, emotinal attachment in mothers and weight gain [21]. Based on these advantages, KMC might be wildly used for neonatal care in the future.

In the present study, we also found that newborns with breastfeeding-associated jaundice needed a longer duration of phototherapy. The babies with breast-feeding jaundice had a higher peak bilirubin than those with pathological jaundice. Additional, the clinical symptoms appeared early in babies with breastfeeding-associated jaundice, compared that with pathological jaundice. Bertini et al. had indicated that unsatisfactory breastfeeding would lead to high level of bilirubin and weight lost [22]. This results accorded with our conclusion. However, it did not mean that breastfeeding was not suitable for babies. Oppositely, Lawrence et al. had indicated that optimal breastfeeding practices would reduce breastfeeding jaundice and minimize the intensity of breastmilk jaundice [23].

Our study was needed to be improved. Firstly, a large number of study subjects were needed.

Data of large sample might provide accurate information for the conclusion. Secondly, in the previous studies, KMC was reported to cause adverse effects. Lopez-Abel et al. had reported that KMC might induce Arrhythmia [24]. Therefore, a follow-up investigation was needed to verify the effectiveness of KMC for neonatal care.

In conclusion, we prove that newborn babies with breastfeeding-associated jaundice need a longer duration of phototherapy than those with pathological jaundice. KMC is a useful way to reduce time of phototherapy for neonatal jaundice, which is a effective protection to reduce side effects of phototherapy and health care costs. Besides, KMC will promote affection between parents and babies, but their effects on other neonatal disease are needed a further study to verify.

## Disclosure of conflict of interest

None.

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