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Original Article

Neonatology Section

Kangaroo Mother Care versus Prone Position in Preterm Neonates: A Non Randomised Clinical Study

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ABSTRACT

Introduction: One of the major problems of preterm neonates is immature alimentation. This may lead to inadequate weight gain, higher chances of sepsis and increased mortality. Positioning during and after feeding affects nutritional tolerance. Kangaroo Mother Care (KMC) is a method of skin-to-skin contact between mother and neonate, claimed to improve infant outcomes.

Aim: To compare prone and Kangaroo Mother Care positioning of preterm neonates of 28-32 weeks gestational age during orogastric tube feeding.

Materials and Methods: The study was a single-centre Institution-based, non randomised cross-over clinical study, carried out at Sick Newborn Care Unit and Neonatal Intensive Care Unit (NICU), Department of Paediatrics, R.G. Kar Medical College and Hospital, Kolkata, India, from April 2020 to March 2021. The studied parameters included gastric residual volume (three hours postprandial), vital signs like respiratory rate, heart rate, SpO_2 level, body temperature, Capillary Blood Glucose (CBG), also comfort scores using a comfort scale. Total 110 preterm neonates of 28-32 weeks gestational age were sampled as per inclusion criteria and divided into two groups. Each group was fed by orogastric tube feeding in its respective position, in which they were kept for three hours. Vital signs, comfort scores and gastric residual volume were re-assessed. Groups were crossed over on the next day. Statistical analysis was done by t-test.

Results: Of the total 110 neonates, KMC sample and prone position sample were compared after three hours. Heart rate was 147.5±4.3 and 151.08±9.1 beats per minute and respiratory rate 52.8±2.9 and 55.6±4.9 cycles per minute, which were lower in KMC than in prone position. There was better glycaemic control {n=107 (97.27) and 80 (72.73) mg/dL}, higher comfort scores (11.2±1.1 and 10.1±2.0) and minimal to negligible gastric residuals (0.03±0.05 mL and 0.13±0.12 mL) in KMC position, when compared to prone position, respectively.

Conclusion: Kangaroo mother care produced more stable physiological indices, and was more comfortable for preterm neonates and resulted in better feeding, absorption and metabolism.

Keywords: Comfort, Feeding, Orogastric tube, Vital signs

INTRODUCTION

Infants born before 37 weeks from the 1st day of the last menstrual period are termed premature by World Health Organisation (WHO) [1]. Prematurity hampers normal alimentation. Proper nutrition in preterm neonates decreases mortality, improves weight gain and shortens hospitalisation. Neonatal positioning during and after feeding can have significant effect on nutritional tolerance. Different positions have different effects; prone position improves respiration and attenuates regurgitation [2]. Kangaroo Mother Care (KMC) is a technique associated with improved infant and maternal outcomes. The kangaroo position consists of skin-to-skin contact between mother and infant in a vertical position between the mother's breasts with the provider being in a semi-reclining position. Baby's head is turned to one side, in a slightly extended position; hips flexed and abducted; arms flexed; abdomen at the level of mother's epigastrium [3,4]. A Cochrane review on benefits of KMC demonstrated improved exclusive breastfeeding rates at discharge, reduction in the risk of mortality, reduction in nosocomial infection/sepsis, reduction in hypothermia, reduction in length of hospital stay, increase in length head circumference and weight gain [5].

A single homogenous study comparing effects of KMC and prone positioning on preterm neonates is scarce. The present study aimed to fulfil this void in knowledge by directly comparing the two positions in neonates. This will help in re-evaluating the existing knowledge base. KMC and prone positioning are inexpensive interventions, targeted for improved neonatal survival, hence relevant in resource-poor settings.

The aim of the present study was to compare prone and kangaroo mother care positioning of preterm neonates of 28-32 weeks gestational age during intragastric tube feeding. Further research will help in revising treatment guidelines, which could be implemented in health policies. The null hypothesis of the present study was, no difference existed between kangaroo mother care and prone positions after feeding in preterm neonates.

MATERIALS AND METHODS

The study was a single-centre Institution-based non randomised cross-over clinical trial. The study was conducted at Sick Newborn Care Unit (SNCU) and Neonatal Intensive Care Unit (NICU), Department of Paediatrics, R.G. Kar Medical College and Hospital, Kolkata, India for a duration of 12 months, from April 2020 to March 2021. Study population were neonates of 28-32 weeks gestational age.

Ethical clearance was obtained from the Institutional Ethics Committee, R.G. Kar Medical College (Registered with The Drugs Controller General India Registration No. ECR/322/Inst/WB/2013): RKC/171 dated 12.02.2020. Written informed consent was obtained from parents of all neonates enrolled in the study.

Inclusion criteria: Neonates having full consent from parents, gestational age of 28-32 weeks, birth weight of 800 grams or more, mean Appearance, Pulse, Grimace, Activity and Respiration (APGAR) score at birth ≥6, stable physiological indices (heart rate, respiratory rate, SpO_2, body temperature, capillary blood glucose), not on intravenous fluids, feeding expressed breast milk, feeding via gavage feeding, having atleast two days of hospitalisation were included.

Exclusion criteria: Neonates with lack of consent, development of intraventricular haemorrhage, development of necrotising enterocolitis, congenital malformations, having convulsions, sepsis, feed intolerance,

unstable vital signs, on mechanical ventilation or Continuous Positive Airway Pressure (CPAP) were excluded.

Sample size calculation: The formula for calculation of sample size for comparison between two groups when end point is quantitative data, was:

$$N=[2\times SD^2\times(Z_\alpha+Z_\beta)^2]\div d^2$$

Where, SD=Standard Deviation (from previous study by Ozdel D and Sari HY [6];

Z is standard normal variate:

Z_α=1.96 at Type 1 error of 5% (p-value <0.05),

Z_β=0.84 at 80% power;

d is effect size (difference between mean values).

SD^2=35.93; $(Z_\alpha+Z_\beta)^2$=7.84; d^2=10.24.

On calculating, the sample size was found to be 55.02. Hence, the sample size for this study was set as 55 for each group. Total sample size of 110 neonates were divided into two groups A and B.

Study Procedure

On the first day, group A neonates were placed in kangaroo mother care position intermittently and group B neonates were placed in prone position intermittently. They were fed by orogastric tube feeding in their respective positions by the prescribed amount of expressed breast milk. Vital signs (respiratory rate, heart rate, SpO_2, body temperature, capillary blood glucose) and comfort scores of the neonates were assessed 10 minutes before feeding while the neonates were supine. The neonates were then placed in their respective positions and feeds were given 10 minutes afterwards. The neonates were kept in their respective positions for three hours, at the end of which vital signs were reassessed. The neonates were then kept supine and comfort scores reassessed by their positions. Postprandial gastric residual volume was measured by aspirating gastric contents from the orogastric tube gently into a 2 mL syringe three hours after feeding. Heart rate and SpO_2 were measured by pulse oximetry while CBG was measured by point of care glucometry. Body temperature was measured with digital thermometer via axillary route. All the readings were recorded in preformed and pretested score cards. Such readings were taken four times in a day at 6 am, 12 pm, 6 pm and 12 am. The same procedure was repeated on the second day but now, groups were crossed over to eliminate confounding factors, i.e., group A neonates were placed in prone positions intermittently while group B neonates were placed in KMC positions intermittently. The same readings were taken.

Data gathering tool was a form with two sections. Section 1 dealt with demographics of the participants. In section 2, a table was made which was used for recording the parameters at the four specified time intervals of the day. The parameters were: amount of expressed breast milk fed (at 6 am, 12 pm, 6 pm and 12 am), volume of gastric aspirate/ three hours postprandial gastric residual volume (at 9 am, 3 pm, 9 pm and 3 am), vital signs such as respiratory rate, heart rate, SpO_2 level, body temperature, capillary blood glucose recorded 10 minutes before feed (at 5:50 am, 11:50 am, 5:50 pm and 11:50 pm) and three hours after feed (at 9 am, 3 pm, 9 pm and 3 am), comfort scores were-recorded 10 minutes before feed (at 5:50 am, 11:50 am, 5:50 pm and 11:50 pm) and three hours after feed (at 9 am, 3 pm, 9 pm and 3 am), using appropriate comfort scale, which was Infant Position Assessment Tool (IPAT) [Table/Fig-1] [4]. The average of the four readings of each parameter was taken for each participant in each position.

STATISTICAL ANALYSIS

Data was entered in Microsoft Excel spreadsheet and analysed using software RStudio version 1.3.1056. Test applied was t-test and p-value <0.05 was taken as statistically significant.

Indicators	0	1	2	Total score
Head	Head rotated laterally (L or R) greater than 45° from midline	Head rotated laterally (L or R) 45° from midline	Head positioned midline to less than 45° from midline (L or R)	
Neck	Neck hyperextended	Neck neutral but poorly aligned with spine	Neck in neutral position and slightly flexed to align with spine	
Shoulders	Shoulders retracted	Shoulders flat/ neutral	Shoulders softly rounded forward	
Hands	Hands away from the body	Hands touching torso	Hands touching face, hands on chest in midline	
Arms	Arms extended	Arms extended	Arms flexed	
Hips (pelvic position)	Hips abducted/ externally rotated and/or in extension	Hips in alignment but extended	Hips aligned and softly flexed	
Knees, ankles, feet	Knees extended, ankles and feet externally rotated	Knees, ankles and feet extended	Knees, ankles and feet are aligned in midline orientation and softly flexed	

[Table/Fig-1]: Infant Position Assessment Tool [4].
IPAT Scores- 0, 1, 2 signify increasing level of comfort in position; Individual scores were obtained for 110 neonates in both positions ; Maximum score: 12 points; Minimum score: 0; An optimal IPAT score ranges between 10 to 12 points; Ideal acceptable score ≥9 points; Scores ≤8 points indicate that the infant is in need of positioning support that offers containment, promotes flexion and ensures proper body alignment [4]

RESULTS

In the present study, 31 neonates amongst the 110 sample were of 30 weeks gestational age, contributing to 28.18% followed closely by 27 (24.54%) neonates with a gestational age of 31 weeks. Neonates were taken with birth weights ranging from 0.8 kg to 1.499 kg and were divided into weight bands of 99 grams. 34 neonates belonged to the weight band of 1.0 to 1.099 kg, showing highest percentage of 30.91%. The mean birth weight was 1.1 kgs. Sixty neonates were girl babies (54.55%) while 50 neonates were boy babies (45.45%). In the present study, 60 neonates (54.55%) were born by caesarean section while, the rest were delivered by normal vaginal delivery. A maximum of 40 neonates showed a mean APGAR score of 8 (36.36%) followed closely by 34 newborns (30.9%) with a mean APGAR score of 9. The total mean AGPAR score was 7.9 [Table/Fig-2].

Variables		Range	Mean±Standard deviation
Gestational age (weeks)		28-32	30.3±0.1
Birth weight (kg)		0.8-1.499	1.1±0.2
Mean APGAR		6-9	7.9±0.9
Variables		**n (%)**	
Sex	Male	50 (45.45)	
	Female	60 (54.55)	
Mode of delivery	Caesarean section	60 (54.55)	
	Normal vaginal delivery	50 (45.45)	

[Table/Fig-2]: Demographic characteristics of the neonates.
APGAR: Appearance, pulse, grimace, activity and respiration

All vital parameters as well as comfort scores were recorded before positioning to obtain baseline values. These baseline values of vital parameters were all within normal range. Hence, before positioning the neonates in either position, it was shown that all neonates were physiologically stable and comfortable.

Total 22 neonates (20%) had tachypnoea (respiratory rate >60 per minute) after being placed in prone position as opposed to only three neonates (2.73%) who had tachypnoea after KMC positioning. The mean respiratory rate in KMC position was 52.8 per minute while that in prone position was 55.6, implying lower and more normalised respiratory rate after being fed in KMC position. About 22 neonates (20%) had tachycardia (heart rate >160 beats per minute) after prone positioning as compared to only 3 neonates (2.73%), who

had tachycardia after being placed in KMC position. The mean heart rate in KMC position was 147.5 beats per minute while that in prone position was 151.08 beats per minute, implying lower and more normalised heart rate after being fed in KMC position. A higher number of neonates i.e., 42 (38.18%) attained SpO_2 of 99% after being placed in KMC position while 36 neonates (32.73%) attained SpO_2 of 99% after being placed in prone position. The mean SpO_2 was however similar; being 97.9% and 97.7% respectively in KMC and prone positions. Neonates placed in KMC position attained body temperature of 37.3-37.6°C, with a maximum of 52 babies (47.27%) having ideal physiological body temperature of 37.5°C, whereas neonates placed in prone position attained a body temperature of 36.6-37.3°C. The mean temperatures were 37.5°C in KMC position while 37.0°C in prone position. Thirty neonates (27.27%), following prone positioning had hyperglycaemia (CBG >125 mg/dL), most likely ascribed to stress, as opposed to only 3 neonates (2.73%) placed in KMC position, suggesting increased comfort and more normalised metabolism in KMC position. 107 out of 110 newborns representing 97.27% neonates had comfort score >8 (acceptable IPAT scores) after positioning in KMC compared to 88 neonates (80%) in prone position having an IPAT score >8. The mean scores, in KMC and prone positions, were respectively 11.2 and 10.1. Hence, contrary to prone position comfort levels were higher in KMC. With respect to gastric residual volume, 80 neonates amongst 110 (72.73%) in KMC had no gastric residuals as opposed to only 37 (33.64%) in prone position. The range of volume was less in KMC, being 0.1-0.2 mL as opposed to prone where it was 0.1-0.3 mL. The mean gastric residual volume was 0.03 mL in KMC position contrary to 0.13 mL in prone position. All these figures clearly signify better alimentation and utilisation of nutrients in KMC position [Table/Fig-3].

Parameters		Kangaroo mother care (Mean±SD)	Prone position (Mean±SD)	p-value (t-test)
Mean respiratory rate (breaths per minute)				
10 minutes before feed		55.5±2.1	56.8±1.9	<0.001
3 hours after feed		52.8±2.9	55.6±4.9	
Mean heart rate (beats per minute)				
10 minutes before feed		150±3.1	150±4.1	<0.001
3 hours after feed		147.5±4.3	151.08±9.1	
Mean SpO_2 (%)				
10 minutes before feed		95.9±1.5	95.7±1.3	0.217
3 hours after feed		97.9±1.2	97.7±1.2	
Mean body temperature (°C)				
10 minutes before feed		37.0±0.2	36.9±0.2	<0.001
3 hours after feed		37.5±0.1	37.0±0.2	
Mean comfort score				
10 minutes before feed		9.6±0.7	9.6±0.7	<0.001
3 hours after feed		11.2±1.1	10.1±2.0	
Gastric residual volume (mL)				
3 hours after feed		0.03±0.05	0.13±0.12	<0.001
Blood glucose concentration		**Percentage**	**Percentage**	
10 minutes before feed (45-125 mg/dL)		100%	100%	<0.001
3 hours after feed	45-125 mg/dL	97.27%	72.73%	
	>125 mg/dL	2.73%	27.27%	

[Table/Fig-3]: Comparison of the vital signs, comfort scores and gastric residual volume of preterm neonates in kangaroo mother care and prone positions.
*p-value <0.05 was considered statistically significant

DISCUSSION

The Cochrane review on benefits of KMC demonstrated improved exclusive breast feeding at discharge or 40-41 weeks' postmenstrual age and at 1-3 months' follow-up; reduction in the risk of mortality; reduction in nosocomial infection or sepsis; reduction in hypothermia; reduction in length of hospital stay with mean difference being 2.4 days; increase in weight gain with mean difference being 4.1 gm/day; increase in length with mean difference being 0.21 cm/week; increase in head circumference gain with mean difference being 0.14 cm/week [5]. Prone positioning stabilises the chest wall and may reduce apnoea [7].

In the study conducted by Miltersteiner AR et al., mean gestational age was 34 weeks, mean birth weight was 1.78 kg, male: female ratio was 13:7, caesarean deliveries were 43% while normal vaginal deliveries were 57% [8]. In a study, conducted by Bera A et al., mean gestational age was 33.2±3.3 weeks, mean birth weight was 1.45±0.31 kg [9]. In the study, conducted by Ozdel D and Sari HY, mean gestational age was 30.2±2.6 weeks ranging between 24 to 34 weeks, mean birth weight was 1.45±0.6 kg, 25 neonates were delivered by caesarean section while five neonates were delivered by normal vaginal delivery and there were nine female with 21 male neonates [6]. In the present study, most of the neonates were of 30 weeks gestational age, with birth weight around 1.1 kg. Majority were females; majority were delivered by caesarean section; most neonates had an APGAR score around 8 at birth.

Moore ER et al., found higher body temperature, increased SpO_2, decreased respiratory rate following KMC positioning [10]. In the study conducted by Bera A et al., mean temperature was increased by 0.4°C; respiratory rate increased by three per minute; heart rate increased by five beats per minute; SpO_2 increased by 5% after 1-3 hours of KMC position [9]. In the study, by Defilipo EC et al., there was significant reduction in respiratory rate and distress (as assessed by Silverman Anderson scoring system) after 90 minutes of KMC position while other vital signs showed no difference [11]. In the study conducted by Ozdel D and Sari HY, there was a decline in mean heart rate by nine beats per minute, decline in mean respiratory rate by 3.2 breaths per minute, rise in mean SpO_2 by 0.57%, rise in mean body temperature by 0.03°C in KMC position as compared to prone position, 30 minutes after placing in KMC position and three hours after placing in prone position postfeeding [6]. In the present study, the mean respiratory rate and heart rate in KMC position was lower and more normalised than that in prone position. A higher number of neonates had tachypnoea and tachycardia in prone position three hours after feed as compared to KMC position, signifying discomfort. The mean SpO_2 in the two positions were almost similar. Several studies have established the positive effects of prone position on ventilation and oxygenation, which could lead to similar saturations in both [6,8,9,12-14]. Neonates placed in KMC position attained body temperature nearer to normal physiological body temperature of 37.5°C as compared to those placed in prone position. This is because KMC keeps neonates warm and protects against cold stress and hypothermia [15]. Stress causes hormonal and metabolic changes [16]. Higher number of neonates had hyperglycaemia after being placed in prone position as compared to KMC position. The findings were consistent with previous studies [8-11].

In the study, conducted by Ozdel D and Sari HY, there was a significant reduction of mean comfort scores by 2.8, 30 minutes after feeding and by 8.17, three hours after feeding in KMC position as compared to prone position. In the present study, the mean comfort score in KMC position was higher than that in prone position. More neonates had comfort score ≤8 (unacceptable) in prone position than in KMC [6].

In the present study, the mean gastric residual volume was lower in KMC as compared to prone position three hours after feeding. Though there are limited studies available on gastric residual volumes in preterms. Chen SS et al., found lower gastric residual volume in prone position as compared to supine position; whereas, Valizadeh S et al., found lower gastric residual volume in KMC position as compared to supine position two hours after feeding [17,18]. In the study conducted by Ozdel D and Sari HY, there was a reduction in mean gastric residual volume by 0.06 three hours after feeding. Hence, these findings were consistent with former studies [6,18].

Limitation(s)

The present study was a single-centre study of short period (12 months) only. This period needed to be longer for more accurate results. Neonates were not randomised for feeding position. Further studies with randomisation for a longer duration of time can be conducted in future.

CONCLUSION(S)

Kangaroo mother care position resulted in more stable vital signs and physiological indices, more comfort and better feeding evidenced by minimal or negligible gastric residual volume, as compared to prone position. Hence, it can be concluded that, kangaroo mother care is a much better position as compared to prone position during feeding in preterm neonates. Kangaroo mother care and prone positioning have the capabilities of better neonatal survival and outcome, especially in resource-limited countries.

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