ORIGINAL ARTICLE

Effectiveness of Kangaroo Mother Care in Early Weaning of Oxygen Therapy among Preterm Neonates in a Tertiary Care Hospital: A Quasi-Experimental Study

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Abstract

Introduction: Kangaroo Mother Care is a cost-effective intervention based on skin-to-skin contact and exclusive breastfeeding that improves survival in preterm and low birth weight infants. Early initiation of Kangaroo Mother Care during respiratory support has shown benefits in stabilizing vital parameters and improving oxygenation. The aim of this study was to find out the effectiveness of early Kangaroo Mother Care during oxygen therapy in preterm neonates.

Methods: This was a quasi-experimental study conducted among 59 preterm neonates of less than 37 weeks of gestation who were on assisted respiratory support, admitted in neonatal ward and neonatal intensive care unit of Tribhuvan University Teaching Hospital from May 2023 to March 2024. Ethical approval was obtained from the Institutional Review Board of the Institute of Medicine (Reference no: 545(6-11) E2). The enrolled neonates were alternately assigned to the two groups interventional and conventional care group. Neonates in intervention group were started on KMC while still receiving oxygen therapy while the conventional care group received daily routine care. Data was collected in predesigned performa and was entered in Statistical Package for the Social Sciences version 26.

Results: The duration of oxygen therapy was shorter in the Kangaroo Mother Care group than in the conventional group, with a mean difference of 29.30 h (95% CI 45.98 to 12.62; p=0.001). Hospital stay was shorter in the same group (6.47± 2.84 vs 7.55±3.74 days; p=0.215). Complications were also less frequent, and vital parameters improved significantly after one hour of Kangaroo Mother Care.

Conclusions: Early Kangaroo Mother Care during oxygen therapy reduces duration of oxygen therapy, hospital stay and neonatal complications along with stabilization of vital parameters.

Keywords: *kangaroo mother care; oxygen therapy; preterm neonates.*

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Introduction

Kangaroo Mother Care (KMC) is a simple, cost-effective intervention characterized by continuous skin-to-skin contact between mother and infant, support for breastfeeding and early discharge with appropriate follow-up.[1] According to the World Health Organization (WHO) nearly 15 million babies are born prematurely each year with the greatest burden in low and middle income countries (LMICs) where neonatal intensive care resources are limited.[2] Preterm infants frequently experience respiratory complications due to structural and functional immaturity of the lungs, including Respiratory Distress Syndrome (RDS) and apnea of prematurity.[3] Preterm delivery remains a leading cause of neonatal morbidity and mortality.[4]

Multiple randomized controlled trials and meta-analyses have established that KMC reduces neonatal mortality, sepsis, and hypothermia while improving breastfeeding success, thermoregulation and weight gain.[5-7] Similarly, Arya et al. demonstrated that immediate KMC reduced neonatal sepsis by 18% compared to delayed KMC.[8] These findings have influenced global policy, with the WHO's 2022 guideline now recommending initiation of KMC immediately after birth, including for unstable preterm neonates who do not require invasive ventilation.[2]

We hypothesized early initiation of KMC, even during ongoing oxygen therapy, would facilitate earlier weaning from oxygen, stabilize vital signs, reduce neonatal complications and shorten hospital stay compared to conventional care, for which a quasi-experimental study was conducted.

Methods

This was a quasi-experimental study conducted in the Neonatal Intensive Care Unit (NICU) and neonatal wards of TUTH. The study duration was 10 months from May 2023 to March 2024. Ethical approval was obtained from the Institutional Review Board of the Institute of Medicine, TUTH. (Reference no: 545(6-11) E2).

Inclusion criteria were all stable preterm neonates less than 37 weeks requiring oxygen via nasal cannula or Continuous Positive Airway Pressure (CPAP) and parental consent. Exclusion criteria included neonates with major congenital anomalies, those requiring invasive mechanical ventilation, inotropes at admission, neonates less than 1000 g and less than 28 weeks of gestation. For the enrollment in the study, babies fulfilling the criteria were selected alternatively into the interventional group and the conventional group.

Sample size was calculated using the formula.

$$n = \frac{(z_1 + z_2)^2 \times 2 \times (s^2)}{(\mu_2 - \mu_1)^2}$$

Sample size was calculated to be 27 in each group, and 10-12% extra was added in each group as some patients could leave the study or maybe be lost to follow-up. Thus the sample size was 62 (i.e. 31 in KMC and 31 in conventional group). For sample size calculation, findings from the study done by Ricero-Luistro et.al. were used.[9]

After explaining about the study procedures, informed written consent was taken from parents. Babies who were selected for the interventional group were kept in KMC with their parents for at least one hour a day up to a maximum time as long as the baby and parents were comfortable. The physiological parameters were recorded fifteen minutes before starting KMC and after one hour of keeping the baby in KMC. The findings were documented in the proforma by the investigator each day.

In babies who developed any complications like hypothermia, prolonged apneic episodes or desaturation during KMC, this was discontinued, and the investigator or duty doctor was informed, and the baby was managed accordingly. KMC was continued till discharge or if the baby met criteria for discontinuation, whichever was earlier.

Similarly, in the conventional group, the baby's birthweight and baseline vitals were taken after enrolling in the study. Their physiological parameters were taken once daily using the same instruments as in the KMC group and were recorded till they were weaned off from oxygen therapy. KMC was also initiated in the conventional care group after weaning off from oxygen support. In both groups, babies were followed till discharge.

Three neonates, 1 from KMC group, 2 from conventional group were excluded as they developed complications, therefore 59 cases were analyzed.

Data were collected prospectively and entered into a predesigned proforma by the investigator. Their vitals were collected and recorded for each individual case by the investigator and were entered and analyzed using Statistical Package for the Social Sciences (SPSS) version 26. Continuous variables were presented as mean ± Standard Deviation (SD) and compared between groups using independent t-tests. Categorical variables were analyzed with chi-square or Fisher's exact test. A p-value <0.05 was considered statistically significant. Confidence intervals were reported where relevant.

Results

There were no significant differences between groups in maternal age, risk factors, gestational age, birth weight, sex distribution, or APGAR scores. (Table 1)

Table 1: Maternal and Neonatal baseline characteristics

Characteristics	Interventional group n(%)	Conventional group n(%)
Maternal Characteristics		
Maternal age in years (mean ± SD)	28.17±3.41	28.71±3.39
Maternal Gravida		
• Primigravida	17(56.66)	15(51.72)
• Multigravida	13(43.33)	14(48.27)
Mode of delivery		
• Vaginal	4(13.33)	3(10.34)
• Cesarean section	26(86.66)	26(89.65)
Maternal and fetal risk factor		
• Previous caserean with scar tenderness	1(3.33)	1(3.44)
• Preeclampsia	7(23.33)	6(20.68)
• Premature rupture of membrane	5(16.66)	6(20.68)
• Severe Oligohydramnios	3(10)	4(13.79)
• Abnormal Doppler	4(13.33)	3(10.34)
• Preterm labor	5(16.66)	4(13.79)
• Decreased fetal movement	3(10)	2(6.89)
• Others	2(6.66)	3(10.34)
Education		
• Illiterate	3(10)	2(6.89)
• Literate	27(90)	27(93.10)
Maternal Antenatal steroid		
1. Not received	5(16.16)	5(17.24)
2. Received	25(83.33)	24(82.75)
-Completed	5(20)	12(50)
-Incomplete	20(80)	12(50)
Neonatal Characteristics		
Gestational age in weeks (mean ± SD)	33.21±1.22	33.14±0.90
Gender		
• Male	22(73.33)	20(68.96)
• Female	8(26.66)	9(31.03)
Apgar score (mean ± SD)		
• 1 min	6.51±0.66	6.33±0.70
• 5 min	7.70±0.52	7.44±0.56
Birth weight in grams (mean ± SD)	1729.17±189.19	1665.22±201.64
• SGA	19(63.33)	22(75.86)
• AGA	11(36.66)	7(24.13)
• LGA	-	-
Babies on oxygen support		
• CPAP	21(70)	22(75.86)
• Nasal prongs	9(30)	7(24.13)
Received Surfactant		
• Yes	5(16.66)	6(20.68)
• No	25(83.33)	23(79.31)
Respiratory diagnosis		
• Transient Tachypnea of Newborn	8(26.66)	6(20.68)
• Hyaline membrane disease	20(66.66)	23(79.31)
• Neonatal pneumonia	2(6.66)	-

The average duration of oxygen therapy was significantly lower in the KMC group (75.80±26.90 h) compared to the conventional group (105.10±36.50 h), corresponding to a mean reduction of 29.30 hours (95% CI: 45.98 to 12.62; p=0.001). In the KMC group, the median duration of oxygen therapy was 75 hours. The duration ranged from a minimum of 25 hours to a maximum of 140 hours. In contrast, the conventional group had a median duration of oxygen therapy of 90 hours with a range from 60 to 170 hours.

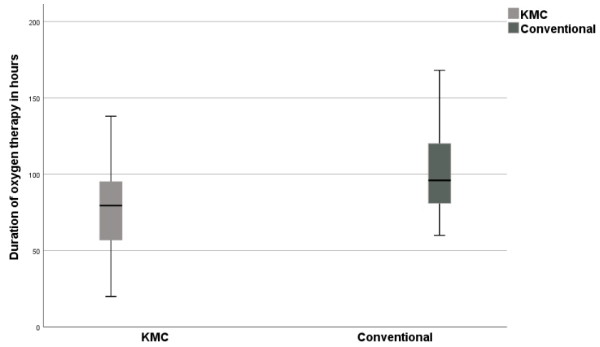

Figure 1: Duration of oxygen therapy in the KMC group compared to the conventional care group

The average hospital stay was shorter among neonates in the KMC group (6.47±2.84 days) compared to the conventional group (7.55±3.74 days) (p=0.21), but this difference was not clinically significant. In the KMC group, the median duration of hospital stay was 6 days, ranging from a minimum of 3 days to a maximum of 9 days. In contrast, the conventional group had a median hospital stay of 7 days, ranging from 4 to 12 days.

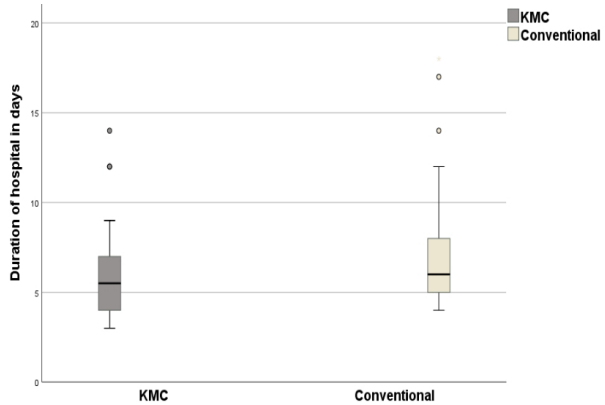

Figure 2: Duration of hospital stay in the KMC group and conventional care group

Apnea occurred in 4 (13.33%) of KMC infants versus 7 (24.13%) in conventional (p=0.333). Neonatal sepsis was observed in 2 (6.66%) of KMC infants compared to 5 (17.24%) of conventional (p=0.254). Necrotizing Enterocolitis (NEC) was noted in 1 (3.33%) and 2 (6.89%) of the KMC and conventional groups, respectively (p=0.61)

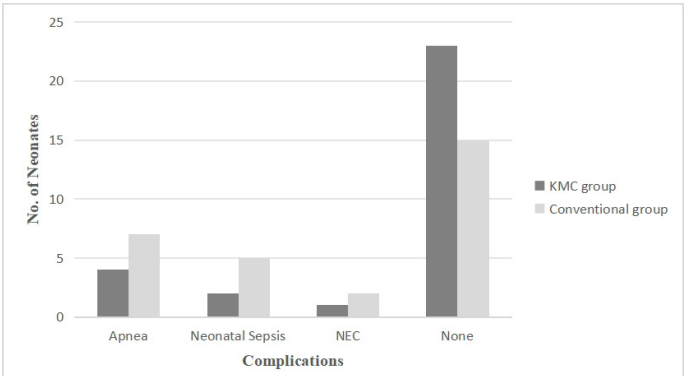

Figure 3: Comparison of complications between the KMC group and the conventional care group.

KMC group received a mean duration of (2.80±0.55) hours of Kangaroo Mother Care per day, with the duration ranging from a minimum of 2 hours to a maximum of 4 hours per day. There were consistent improvements in physiological parameters in heart rate, respiratory rate, body temperature, and oxygen saturation (Spo2) after 1 hour of KMC. (Table 2)

Table 2: Comparisons of physiological parameters before and after 1 hour of KMC sessions in the KMC group

Vitals signs	Before KMC (mean±SD)	1 hour after KMC (mean±SD)	Difference in mean (95%CI)	p -value
Day 1				
Heart rate	158.30 ± 11.87	155.10± 10.03	3.20(1.07-5.32)	0.004
Respiratory rate	65.90 ± 7.39	62.60 ± 5.26	3.30(1.72-4.87)	<0.001
Temperature	98.55 ± 0.21	98.78± 0.22	-0.22(-0.29- 0.16)	<0.001
SPO2	94.07± 1.43	94.73± 1.25	-0.66(-1.21 - 0.11)	0.019
Day 2				
Heart rate	150.90± 8.68	149.30±9.35	1.60(0.15-3.04)	0.031
Respiratory rate	58.90±6.32	56.47±5.97	2.43(1.29-3.57)	<0.001
Temperature	98.51±0.22	98.70±0.21	-0.19(-0.26-0.13)	<0.001
SPO2	95.90±1.47	96.57±1.33	-0.66(-1.10-0.22)	0.004
Day 3				
Heart rate	149.59±7.96	147.82±9.21	1.76(-0.05 - 3.58)	0.057
Respiratory rate	54.94±5.73	52.24±6.11	2.70(0.63-4.77)	0.014
Temperature	98.65±0.24	98.82±0.22	-0.16(-0.31-0.012)	0.035
SPO2	96.35±1.16	97.41±1.27	-1.05(-1.67-0.44)	0.002
Day 4				
Heart rate	150.17±5.34	147.17±6.27	3.00(0.10-5.89)	0.045
Respiratory rate	51.83±3.37	49.33±3.67	2.50(1.92-3.07)	<0.001
Temperature	98.46±0.10	98.78±0.13	-0.31(-0.50-0.12)	0.008
SPO2	96.33±1.03	98.17±0.40	-1.833(-2.86-0.80)	0.006

Discussion

In this study, the mean duration of oxygen therapy in the KMC group (75.80±26.96 hours) was significantly shorter compared to (105.10±36.46 hours) in the conventional care group. A similar interventional study by Ricero-Luistro et al. involving 70 preterm infants (28–36 weeks of gestation) receiving oxygen via CPAP also found mean duration of oxygen therapy in the KMC group of (54.03± 42.46) hours compared to (129.43±108.84) hours in the conventional care group with p-value of 0.002.[9] Similarly, another interventional study done by Punasanvala et.al on 28 preterm newborns of 26-36 WOG receiving oxygen via CPAP also showed similar result. The mean duration of oxygen therapy in KMC group, (40.36±12.99) hours, was shorter compared to (52.21±24.37) hours in non-KMC group but this was not statistically significant (p value of 0.125).[10] Across studies, the duration of oxygen therapy was consistently shorter in the KMC group compared to conventional care, although Punasanvala et al. did not observe statistically significant results. This might be due to their smaller sample size, which likely limited the study's power to detect significant differences.

In this study, the KMC group had a shorter duration of hospital stay (6.47±2.84 days) compared to the conventional care group (7.55±3.74 days), but this was not statistically significant (p value 0.215). The study by Ricero-Luistro et al. also found a reduction in the mean duration of hospital stay (24.63±19.50 days) in the KMC group compared to the conventional care group (28.14±19.48 days) which was not statistically significant (p value 0.872).[9] Similarly in the meta-analysis conducted by Guo et al. encompassing 24 studies from different countries worldwide, including[19], 980 preterm and Low-Birth Weight (LBW) neonates, mean difference in duration of hospital stay between KMC and conventional care groups was -1.43 (95% CI: -2.88 to 0.02, p = 0.05)was not statistically significant.[11] The findings from these studies align with the findings of the current study. This is in contrast to the study by Acharya et al., including 126 preterm and low birth weight infants weighing less than 2000gram, where the mean duration of hospital stay in the KMC group was longer (16.13±5.84days) in comparison to the conventional group (13.14±7.62 days), and this difference was statistically significant (p value 0.015).[12]

In the present study, the conventional care group

also received KMC after being weaned off respiratory support. This may have benefited the conventional care group by reducing complications and boosting maternal confidence, leading to earlier discharge with no significant difference in duration of hospital stay between the two groups. In the meta-analysis by Guo et al., the authors suggested the non-significant result might be due to the high variability among the studies (I^2 = 86%), with many studies included having very small sample sizes. In contrast to our study, Acharya et al. reported a longer hospital stay in the KMC group, which, according to the authors, was most likely due to baseline differences in the weight of enrolled infants. The neonates in the KMC group had less weight (1362.30±240.14 g) compared to the control group (1415±174.91 g), although this was not statistically significant (p value 0.050). However, because according to hospital policy, neonates after attaining a weight of 1.6 kg met the criterion for discharge, the authors propose that babies in the KMC group required more time to reach the discharge threshold, contributing to the extended hospital stay.

In this study, the KMC group observed fewer complications in comparison with the conventional care group, though differences were not statistically significant. In randomized control trial conducted by Arya et al. among 3,211 LBW infants. They found suspected sepsis was 14% lower in the intervention group with weight between 1 to <1.5 kg, [RR 0.86 (95% CI: 0.75, 0.99)] and a 24% lower in the intervention group with birth weights between 1.50 to <1.80 kg, [RR 0.76(95% CI: 0.62, 0.93)]. Sepsis-related mortality was 37% lower in the intervention group compared to the control group. These differences were statistically significant.[8] Also, in the RCT conducted by Ricero-Luistro et.al in 70 preterm, KMC group demonstrated significantly lower complications in comparison with control group.[9]

The difference in finding between the present studies with the studies mentioned above might be because of the larger sample size in study done by Arya et al. The study by Arya et al being a multicenter study included a larger cohort of low- birth-weight infants from multiple countries with varying healthcare settings, which may have resulted in more noticeable differences in complications and also in this study KMC was started immediately within 1 hour after birth and provided continuously maximum up to the 20 hours per day which might be the important factor for the reduction of complications in KMC group. Similarly, in the study by Ricero-Luistro et al. that included neonates of similar gestational and birth weight with a similar sample size to the present study, a significant difference in complications was observed between the KMC and conventional care groups. In this study, all enrolled infants, in both intervention and control groups, were on oxygen therapy via CPAP at enrollment, and the conventional care group did not receive KMC during their hospital stay. In contrast, the present study included neonates receiving oxygen either via CPAP or nasal prongs and KMC was also initiated in the conventional care group once they were weaned from oxygen. This approach may have helped reduce complications in the conventional care group, resulting in no significant difference in complications between the two groups in the current study.

In the present study, the KMC group had significant improvement in vital parameters with stabilization of heart rate, respiratory rate, temperature, and oxygen saturation during KMC. The findings were similar in all four days, with post-KMC vital parameters showing statistically significant improvement. The findings were similar in the study done by Parsa et al. and Bera et al. which both showed the significant improvement in vital parameter during KMC.[13,14] The similarity in findings between the present study and the studies by Parsa et al. and Bera et al. attributed to the well-documented physiological benefits of Kangaroo Mother Care which has been supported by previous studies including a hypothesis proposed by Sehgal et al. suggesting that skin-to-skin contact activate the infant's parasympathetic nervous system, leading to improved vital parameters and overall stability.[15]

This study was single-center conducted at TUTH, which may limit the generalizability of the findings to other settings. Non-random allocation and lack of blinding could have introduced selection and observer bias. In addition, KMC could not be provided for the recommended full duration, 24 hours/day, due to facility limitations, which may have affected the outcomes.

Conclusions

Early initiation of KMC while preterm neonates are still on oxygen therapy is safe, feasible, and effective. It significantly reduces duration of oxygen therapy, stabilizes vital parameters and also reduces complications. Routine implementation of KMC during oxygen therapy should be encouraged in tertiary NICUs in Nepal and similar settings. Further multicenter randomized trials with larger samples are warranted to validate these findings and support scale-up at the policy level.

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