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Original Research Article

SAFETY AND FEASIBILITY OF KANGAROO MOTHER CARE IN NEONATES REQUIRING RESPIRATORY SUPPORT: A PROSPECTIVE OBSERVATIONAL STUDY

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ABSTRAC

Background: KMC provides established benefits for stable neonates, but is often withheld from babies on respiratory support due to safety concerns. Limited evidence exists regarding KMC safety and physiological effects in this population. We aimed to assess the safety of KMC in neonates requiring respiratory support and evaluate its effect on vital parameters.

Materials and Methods: This prospective observational study was conducted in 2023 at a tertiary care NICU in Jaipur, India. Consecutive neonates requiring respiratory support (CPAP, oxygen hood, or nasal prongs) who achieved clinical stability for ≥6 hours were enrolled. Vital signs were recorded before KMC, at 10, 30, 60, 90, 120, 150, and 180 minutes, and at the end of each session. Primary outcomes were predefined safety events (bradycardia, tachycardia, apnea, desaturation, hypothermia). Secondary outcomes were pre- and post-KMC changes in vital parameters.

Results: Twenty-eight neonates contributed 82 KMC sessions. Seventy-nine percent of sessions were incident-free. All incidents (17 sessions) were managed with standard interventions. Of these, 10 (59%) were managed while continuing KMC and 7 (41%) required interruption. Heart rate, respiratory rate, oxygen saturation, and temperature remained stable during KMC. All 7 deaths were attributable to underlying illness.

Conclusion: KMC is safe and feasible in neonates requiring respiratory support, with a high incident-free rate. All vital parameters remained stable, indicating no physiological compromise during KMC.

Keywords: Kangaroo mother care, skin-to-skin contact, preterm, neonate, respiratory support, CPAP.

INTRODUCTION

Kangaroo Mother Care (KMC), defined as prolonged skin-to-skin contact between a baby and caregiver, frequent and exclusive breastfeeding, and early discharge, is a key intervention for stable preterm and low birth weight babies.[1] The World Health Organization recommends KMC as a standard of care for clinically stable low birth weight infants.[2] A previous randomized trial showed reduced nosocomial infection with KMC,[3] and a 2016 Cochrane systematic review confirmed significant reductions in mortality, infection, and hypothermia.[4]

Traditionally, KMC has been restricted to stable neonates,[5,6] and infants requiring respiratory support have been excluded due to concerns about prongs dislodgement, airway maintenance, and desaturation risk.[7] However, newer evidence suggests KMC may be safe even in these infants. Bergman et al,[8] reported in a randomized trial that skin-to-skin contact from birth in 1200–2199 g newborns resulted in better physiological stability compared to incubator care. Earlier studies showed benefits of initiating KMC sooner in low birth weight infants,[9] and the WHO Immediate KMC Study Group,[10] reported that immediate KMC in 3,211 infants (1.0–1.799 kg) reduced neonatal mortality by 25% (12.0%

vs 15.7%, p=0.001), supporting initiation even in less stable infants. Skin-to-skin contact improves behavioral state organization,[11] and may reduce work of breathing through better thermal regulation and decreased metabolic demand.[12]

Despite this evidence, specific safety data for neonates requiring respiratory support remained limited. Systematic documentation of physiological responses during KMC in infants with ongoing respiratory support was lacking. We conducted this study to evaluate the safety and physiological effects of KMC in neonates requiring respiratory support, initiated after a defined period of clinical stability with continuous monitoring.

MATERIAL AND METHODS

Study Design and Setting: This was a prospective observational study conducted in the Neonatal Intensive Care Unit (NICU) of SMS Medical College, Jaipur, India, from January to December 2023. Our unit is a tertiary referral center with high patient turnover.

Participants: All consecutive neonates admitted to the NICU during the study period were screened for eligibility. Neonates aged 0–45 days receiving respiratory support via Continuous Positive Airway Pressure (CPAP), oxygen hood, or nasal prongs, with or without vasopressor support, were eligible if clinically stable for ≥6 hours, defined as non-fluctuating vital parameters that did not suggest impending respiratory or circulatory collapse; oxygen saturation (SpO_2) above 90% on current respiratory support; Downes score <6; capillary refill time <3 seconds during the preceding 6 hours; and the mother or caregiver willing, motivated, and medically fit to provide KMC.

Neonates were excluded if they had active bleeding; were on invasive positive-pressure ventilation; had SpO_2 frequently falling below threshold (<85% for preterm, <90% for term) despite ongoing respiratory support; had multi-organ dysfunction; or had sclerema, extensive open wounds, or burns. All eligible neonates were enrolled consecutively. No a priori sample size calculation was performed.

Procedures: Before each session, the baby's airway was assessed, and suction was done if required. The baby, wearing only a diaper, was placed prone on the mother's bare chest with the baby's head turned to one side and the neck slightly extended. A light blanket covered the mother and baby. Respiratory support was maintained throughout the session. Sessions continued for as long as tolerated by the mother-baby dyad, or until interrupted for any documented reason.

A pediatrician continuously monitored vital parameters during each session. KMC was interrupted in the event of any unfavorable event, and standard NICU management was started; the decision to continue or interrupt for minor events was made by the attending pediatrician. Interventions included tactile stimulation, repositioning, oropharyngeal suctioning, or brief interruption of the session. All incidents and decisions were documented.

Data Collection: Heart rate and SpO_2 were monitored continuously by pulse oximetry throughout each session. Respiratory rate was counted manually by observing the baby's chest rise for one minute. Axillary temperature was measured by a digital thermometer. Downes score[13] was recorded before each session.

Vital signs were documented at the following timepoints: immediately before KMC session while the baby was still on radiant warmer; at 10, 30, 60, 90, 120, 150, 180 minutes during KMC; and at the end of the session while the baby was still in KMC, just before transfer back to the warmer.

Baseline data included birth weight, gestational age, postnatal age, diagnoses, and type of respiratory support. Final outcome, either discharge, or death, was recorded once available.

Outcome Measures: Primary outcome measures were the incidence of bradycardia (HR <100 bpm) or tachycardia (HR >180 bpm), apnea (cessation >20 seconds, or any cessation with HR <100 bpm), oxygen desaturation (SpO_2 <85% preterm, <90% term), and hypothermia (axillary temperature <36.5°C). An unfavorable event was defined as any of the above, or any unexplained event requiring KMC discontinuation.

Secondary outcome measures were changes in heart rate, respiratory rate, SpO_2, and temperature from pre- to post-KMC.

Statistical Analysis: Analyses were performed in R version 4.5.1 (R Core Team, 2025).[14] Continuous variables were reported as mean ± SD or median (IQR); categorical variables as n (%). Each KMC session was considered as a distinct unit for the purpose of statistical analysis.

Safety event proportions were reported with exact 95% confidence intervals. Paired comparisons of vital signs (pre-KMC versus post-KMC) were performed using the Wilcoxon signed-rank test. Safety events were compared between CPAP and hood support. A p-value of <0.05 was considered statistically significant.

Ethics: The study was approved by the Institutional Ethics Committee. Written informed consent was obtained from parents or legal guardians in English and Hindi. The study adhered to the Declaration of Helsinki. Participants could withdraw at any time without affecting clinical care.

RESULTS

We enrolled 28 neonates, contributing 82 KMC sessions, and a cumulative KMC duration of 11,797 minutes (196.6 hours). Median sessions per infant was 2 (range 1–10) with a median duration of 132 minutes (IQR 115–179, range 30–300). Baseline demographics, clinical status, and diagnoses are summarised in [Table 1].

Safety events and incident details are presented in [Table 2].

Paired pre-post comparisons are summarised in [Table 3]. Heart rate, respiratory rate, SpO_2, and temperature remained stable from pre- to post-KMC, with no statistically significant changes.

Of 28 neonates, 21 (75%) were discharged and 7 (25%) died during hospitalisation. No death occurred during or immediately after KMC, and none were related to KMC.

Table 1: Baseline Characteristics (N=82 sessions, 28 patients)

Characteristic	Value
Demographics	
Birth weight (g), mean ± SD	1844 ± 653
Birth weight <1500g, n (%)	29 (35%)
Birth weight 1500–<2500g, n (%)	37 (45%)
Birth weight ≥2500g, n (%)	16 (20%)
Gestational age (weeks), mean ± SD	32.8 ± 3.6
Preterm (<37 weeks), n (%)	67 (82%)
Postnatal age (days), mean ± SD	17.5 ± 11.1
Clinical Status	
Downes score, median (IQR)	2 (2-3)
Downes score 0-2, n (%)	55 (67%)
Downes score 3-5, n (%)	27 (33%)
Respiratory Support, n (%)	
Oxygen hood	44 (54%)
CPAP	36 (44%)
Nasal prongs	2 (2%)
Clinical Diagnoses, n (% patients)†*	
Respiratory distress syndrome	13 (46%)
Sepsis (any type)	13 (46%)
Shock (any)	11 (39%)
Pneumonia	10 (36%)
Neonatal jaundice	9 (32%)
Perinatal asphyxia	8 (29%)
PDA / CHD	4 (14%)
Apnea of prematurity	3 (11%)
Meconium aspiration syndrome	2 (7%)

†Patient-level (N=28); many patients had multiple diagnoses

Table 2: Safety Outcomes During KMC Sessions (N=82)

Outcome	Value
Primary Safety Events	
Bradycardia	0 (0%)
Tachycardia	5 (6%)
Apnea	6 (7%)
Oxygen desaturation	8 (10%)
Hypothermia	9/29* (31%)
Incidents	
Incident-free sessions	65 (79%; 95% CI 69–87%)
Sessions with incident	17 (21%; 95% CI 13–31%)
Types of Incidents†	
Desaturation	8
Apnea	6
Procedural (blood sampling, ROP screening, milk expression)	3
Management Interventions†	
Suctioning (oral/nasal)	10
Tactile stimulation	3
Repositioning (infant or equipment)	3
KMC Continuation During Incidents	
Managed while continuing KMC	10/17 (59%; 95% CI 33–82%)
Sessions interrupted and terminated	7/82 (9%; 95% CI 4–17%)
By Illness Severity	
Incidents in Downes 0-2 sessions (n=55)	8 (15%; 95% CI 6–27%)
Incidents in Downes 3-5 sessions (n=27)	9 (33%; 95% CI 17–54%)
By Respiratory Support	
Incidents in CPAP sessions (n=36)	8 (22%; 95% CI 10–39%)
Incidents in hood sessions (n=44)	8 (18%; 95% CI 8–33%)

*Denominator is 29 sessions normothermic at baseline with temperature data during KMC
†Some sessions had multiple incidents or interventions

Table 3: Physiological Outcomes: Pre-KMC versus Post-KMC Comparisons

Parameter	Pre-KMC Mean ± SD	Post-KMC Mean ± SD	Median Change (IQR)	P value*
Heart Rate, bpm (n=82)	149.3 ± 17.7	148.1 ± 17.2	-2.5 (-11.8 to +9.0)	0.393
Respiratory Rate, breaths/min (n=82)	54.0 ± 15.6	51.2 ± 14.5	0.0 (-8.0 to +4.8)	0.136
SpO_2, % (n=81)	97.0 ± 3.6	96.8 ± 4.0	0.0 (-2.0 to +1.0)	0.647
Temperature, °C (n=46)†	36.8 ± 0.9	36.7 ± 0.7	0.0 (-0.5 to +0.6)	0.901

*Wilcoxon signed-rank test (two-tailed, exact=FALSE)
†Temperature pairs limited due to missing data (44%).

DISCUSSION

In this study, KMC was safely provided to neonates requiring respiratory support. Most incidents were managed without stopping KMC, and babies whose sessions were interrupted received KMC again in later sessions. The higher incident rate with higher Downes scores likely reflected baseline severity rather than a KMC-related risk.

All vital parameters (heart rate, respiratory rate, SpO_2, and temperature) remained stable during KMC, with no statistically significant pre-post changes, indicating that KMC did not compromise cardiorespiratory functions in neonates on respiratory support.

Few studies have specifically examined KMC safety in neonates on respiratory support. Punasanvala et al,[15] reported no significant adverse events during KMC in neonates receiving CPAP or oxygen hood, consistent with our findings. Khanna et al,[16] (2025) showed in a randomized trial that KMC initiated within one hour of CPAP resulted in higher CPAP success rates and shorter CPAP duration, adding efficacy data to the safety profile we describe. A recent systematic review by Sivanandan et al,[17] also supports the safety of KMC in sick neonates.

Limitations: Our study had several limitations. The observational design without a control group limits our ability to attribute the changes directly to KMC. Temperature pairs remained limited (46/82, 56%) because multiple temperature measurements were not feasible due to busy work settings and the need to minimise interruptions to the baby's sleep. This being a single-center study, the findings may not be generalizable to all settings and monitoring capabilities. The sample size (82 sessions, 28 patients) limits subgroup analyses. We did not assess long-term outcomes such as duration of respiratory support or neurodevelopmental outcomes. Session-level analysis was chosen because each session represents a distinct clinical event at a different illness phase (median 2 sessions per infant, up to 10), and the primary outcome, safety proportion, is less affected by clustering.

Strengths of our study include the prospective design with pre-specified safety monitoring, inclusion of a high-acuity population typically excluded from KMC research, and detailed documentation of incidents and management strategies that may be useful for clinicians.

CONCLUSION

In our study, KMC was safe and feasible in neonates requiring respiratory support, meeting the predefined criteria of clinical stability. All adverse events were manageable, and no morbidity or mortality was attributable to KMC. All vital parameters remained stable during KMC, indicating no physiological compromise. Based on our findings, KMC can be considered for neonates on respiratory support, provided stability criteria are met, continuous monitoring is available, and staff are trained to manage incidents during skin-to-skin contact. Multicenter randomized trials with respiratory and mortality outcomes are needed to confirm these findings.

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