

Safety of Kangaroo Mother Care in Intubated Neonates Under 1500 g

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Summary

Kangaroo Mother Care (KMC) has been used as a technique to promote mother–child bonding. It has been discussed of its use for preterm under mechanical ventilation. The objective of this study is to assess the vital signs of preterm infants with a birth weight lower than 1500 g who are under intubation and hemodynamically stable in KMC. Forty-three preterm infants with a mean gestational age at birth of 29.1 ± 1.6 weeks and a mean birth weight of 1.1334 ± 2318 g. The preterm infants were longitudinally assessed for 90 min (15 min before, 60 min in KMC and 15 min after). These periods were compared, and the dependent variables heart rate, oxygen saturation (SpO_2), axillary temperature and mean arterial blood pressure were statistically significant ($p < 0.05$). Clinically, however, the results were not significantly different. The results show that KMC is a safe method under the study conditions presented here.

Key words: preterm infants, kangaroo mother care, mechanical ventilation, neonatal health care, bonding.

Introduction

Currently, the main objective of Kangaroo Mother Care (KMC) is to promote a bond between child and parents [1, 2]. While the birth of a preterm infant is stressful and might hinder the parent–child interaction [3], KMC is universally accepted as a technique that improves parents' adaptation to the conditions and consequences of this event [4, 5].

The use of KMC in preterm infants under mechanical ventilation (MV) is still being discussed although this technique may decrease the need for additional oxygen as the vertical position employed during the procedure improves the efficiency of the diaphragm and pulmonary function, favoring oxygenation and cardiorespiratory stability [6]. One of the earliest KMC reports showed that the technique is safe for intubated preterm infants, and that it can be helpful to approach parent–child [7]. van Zanten *et al.* [8] described preterm infants with ventilation support statistically significant differences ($p \leq 0.05$)

before, during and after KMC with respect to physiological variables but these variation were within the normal limits. However, Smith [9], in a study of 14 preterm infants diagnosed with chronic pulmonary disease under MV, reported instability in the physiological variables (SpO_2 , axillary temperature) described during a 2 h long KMC.

It is still necessary to assess the safety of KMC for at-risk preterm infants, and the present study aimed to analyze the vital signs of preterm infants with weights lower than 1500 g who are intubated and hemodynamically stable in KMC for a period of 1 h.

Methods

We conducted a quasi-experimental study design (pre-test, test, post-test) where the preterm infants acted as their own controls. Subjects were selected from the Neonatal Intensive Care Unit (NICU) of a public hospital in Southeast of Brazil between August 2007 and February 2008. The study was approved by the Ethics Committee of the Federal University of Minas Gerais (311/07).

During the data collection period, 137 preterm infants with weight <1500 g were admitted to the NICU, with a 76.6% survival rate. Of these, 53 were

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eligible for the study (all were intubated and under MV for at least 24 h) and were respiratory and hemodynamically stable (preterm infants who were using a single vasoconstriction drug that would be decreasing and which the neonatologist considered clinically stable)—ventilatory parameters: fraction of inspired oxygen (FiO_2) ≤ 0.4 ; peak inspired pressure (PIP) $\leq 16 \text{ cmH}_2\text{O}$; positive expiratory end pressure (PEEP) $\leq 5 \text{ cmH}_2\text{O}$ and respiratory rate (RR) $\leq 40 \text{ bpm}$). The following exclusion criteria were: newborns (RNs) with high bilirubin levels and requiring phototherapy, the infants of women children with skin changes that would impede the placement kangaroo and those with congenital malformations or diagnosed with intraventricular hemorrhage grades III and IV. None of RNs eligible fulfilled any of the exclusion criteria. However, nine mothers did not consent to the procedure; and one was excluded during the course of the study when the mother refused the procedure (18.6% of the subjects). Considering the largest difference in the variables, sample power calculated for the 43 preterm infants was over 90%.

Procedures

For KMC, a modified version of the protocol by Ludington-Hoe *et al.* [6] was adopted. The preterm infant, wearing only a diaper, was put against the mother's breast, vertically in the prone posture. The mother wore nightgown opened in front and sat in a comfortable 60° reclining chair.

Measures

Data were collected 15 min before, 1 h during and 15 min after KMC. Heart rate (HR), SpO_2 and axillary temperature were collected 15 and 5 min before KMC with the preterm infant still in the incubator; 2 min after starting KMC and every 10 min thereafter; 5 and 15 min after returning to the incubator. MABP was recorded 15 min before KMC; 30 min after the commencement of KMC; 15 min after returning to the incubator. Axillary temperature was taken 15 and 5 min before KMC, every 15 min during KMC and 5 and 15 minutes after KMC. FiO_2 was recorded immediately before KMC; after 2 min and every 10 min during KMC; and after returning to the incubator. Smith's [9] criteria for FiO_2 modification were employed, in which a 10% increase every minute would be observed if SpO_2 were $<85\%$, and a 10% decrease every 15 min if SpO_2 were $>96\%$. Ventilatory parameters were collected immediately before, during (at the 30 min mark) and after KMC.

To avoid possible interference, the mother's axillary temperature, room temperature and incubator temperature were all verified before and immediately after KMC. Additionally, the presence of pain was assessed using the Neonatal Facial Coding System (NFCS) [10] before, 2 min after beginning KMC,

every 20 min during KMC and immediately after KMC. KMC was only initiated if no signs of pain (NFCS ≥ 3) were observed. The KMC would be terminated if, during KMC, the preterm infant presented $\text{SpO}_2 < 85\%$ even with $\text{FiO}_2 = 1.0$ (100%) [9]; axillary temperature $<36^\circ\text{C}$ and $>37.5^\circ\text{C}$ [7]; HR $<100 \text{ bpm}$ and $>160 \text{ bpm}$ [11], as determined by the neonatologist. There was no case of instability during the procedure.

HR and SpO_2 were recorded using pulse oxymetry (Dixtal®); MABP through the non-invasive oscillometric measurement (Dixtal DX-2710®, Manaus, Amazonas, Brazil); axillary temperature was measured using a digital flexible thermometer (BD®).

Statistical approach

Longitudinal data analysis evaluated the variations in HR, FiO_2 , MABP and axillary temperature over time, and each of the covariates: gestational age (GA), days-of-life, days under MV, sex, weight, use of inotropic drugs and sedation. Adjusted linear models of mixed effects (random effects) were calculated. The software packages R and Minitab were used, and a value of $p \leq 0.05$ was considered statistically significant.

Analyses of the mother's axillary temperature and the incubator and room temperature were done by a paired *t*-test. For pain analysis, Fisher's exact test was used and repeated measures were made.

Results

Forty-three preterm infants were included in this study. Preterm infants included in the present study had GA over 29 weeks and mean weight, during intervention, of 1096 g (minimum of 500 g and maximum of 1135 g). Other characteristics of the 43 preterm infants are described in Table 1. During KMC, HR, SpO_2 , axillary temperature and FiO_2 were monitored continuously.

The results of the analysis of vital signs before, during and after KMC are shown in Table 2. It should be noted that HR showed some statistically significant oscillation ($p < 0.001$); however, the results of all the dependent variables shown in Fig. 1 were not clinically significant. The greatest variation of HR was 5 bpm. The maximum variation in temperature was 0.2°C. The covariates days-of-life and MV time were associated with temperature, that is, the higher the covariates, the higher the temperature.

There was a small increase in MABP during KMC, which returned to the initial value after the procedure. Only GA was associated with MABP: the higher the GA, the higher the MABP. The greatest difference in MABP was 4.0 mmHg. FiO_2 decreased mostly significantly, up until 30 min into KMC, after which it decreased less noticeably. Covariates days-of-life and MV time were associated with FiO_2 , and the higher the covariates the higher the value of

TABLE 1
Baseline characteristics of the neonates

	Mean \pm SD	Minimum	Maximum
Gestational age at birth (weeks)	29.1 \pm 1.6	26	33
Apgar score 1'	6.4 \pm 2.3	1	9
Apgar score 5'	8.3 \pm 1.5	5	10
Weight at birth (grams)	1133.4 \pm 231.8	640	1480
Weight at intervention (grams)	1096.3 \pm 249.8	500	1135
Days of life	6.5 \pm 6.1	1	32
MV time ^a (days)	5.8 \pm 4.3	1	18

^aMechanical ventilation.

TABLE 2
Vital signs of the 43 neonates collected before, during and after KMC^a

Vital signs	p-value	Maximum variation	Clinical difference	Variation coefficient
HR	<0.001	5 bpm	No difference	-0.095
Body temperature	<0.05	0.2°C	No difference	-0.002
Oxygen saturation	<0.001	0.7%	No difference	-
Inspired oxygen fraction	<0.001	0.05%	No difference	-0.0004
Mean arterial blood pressure	0.001	4 mmHg	No difference	0.141

^aKMC, kangaroo mother care.

FiO₂. It is worth noting that the FiO₂ variation, even though statistically significant ($p < 0.001$), is clinically negligible (0.05%). SpO₂ decreased over time up until the last measurement, but the greatest SpO₂ variation was 0.7% (95.4–96.1%), which is clinically insignificant. SpO₂ was influenced by the modification in FiO₂, and therefore not considered as a response variable.

There was no change in the ventilatory parameters (PIP, PEEP and RR) and none for the preterm infant needed to be removed prematurely from KMC due to instability. Additionally, there were no statistically significant variations in the mother's axillary temperature and room and incubator temperature ($p > 0.05$).

Preterm infants presented signs of pain only after KMC with significant difference ($p = 0.002$). However, multivariate analysis determined that the variable did not interfere in the vital signs.

Discussion

Under the conditions of the present study, given the data and study duration, there is evidence that KMC is possibly safe. Safety indicators measured before, during and after the procedure did not show clinically significant differences despite being statistically significant.

There was a slight decrease in HR during KMC that could be attributed to the preterm infant's

increased comfort and relaxation, and a slight increase after the procedure probably due to stress caused by moving the child from KMC to the incubator. MABP, on the other hand, increased during KMC probably due to hemodynamic compensation, which returned to original values after the procedure. According to Schrod and Walter [12], KMC might produce orthostatic stress, an effect of the head elevation (in the present study at 60°), in the cerebral and systemic oxygenation and in the circulation and sympathetic-vagal balance reflexes. Head elevation also results in an accumulation of blood in the lower regions of the body, which increases peripheral vascular resistance and decreases venous return and cardiac debt. This fact may explain the significant increase in MABP in this study.

During KMC, sheets of the same thickness covered the preterm infant's entire body, but they were not sufficient to keep them from losing heat. Similar results were described by van Zanten *et al.* [8] in which axillary temperature decreased during KMC and remained low after the procedure, with statistically significant differences ($p \leq 0.05$). However, these variations were well within the normal limits during the whole data collection period. Conversely, Bauer *et al.* [13] reported a study of 27 preterm infants with GA between 25 and 30 weeks, without the use of complementary oxygen, in which there was a decrease in the rectal temperature of the infants

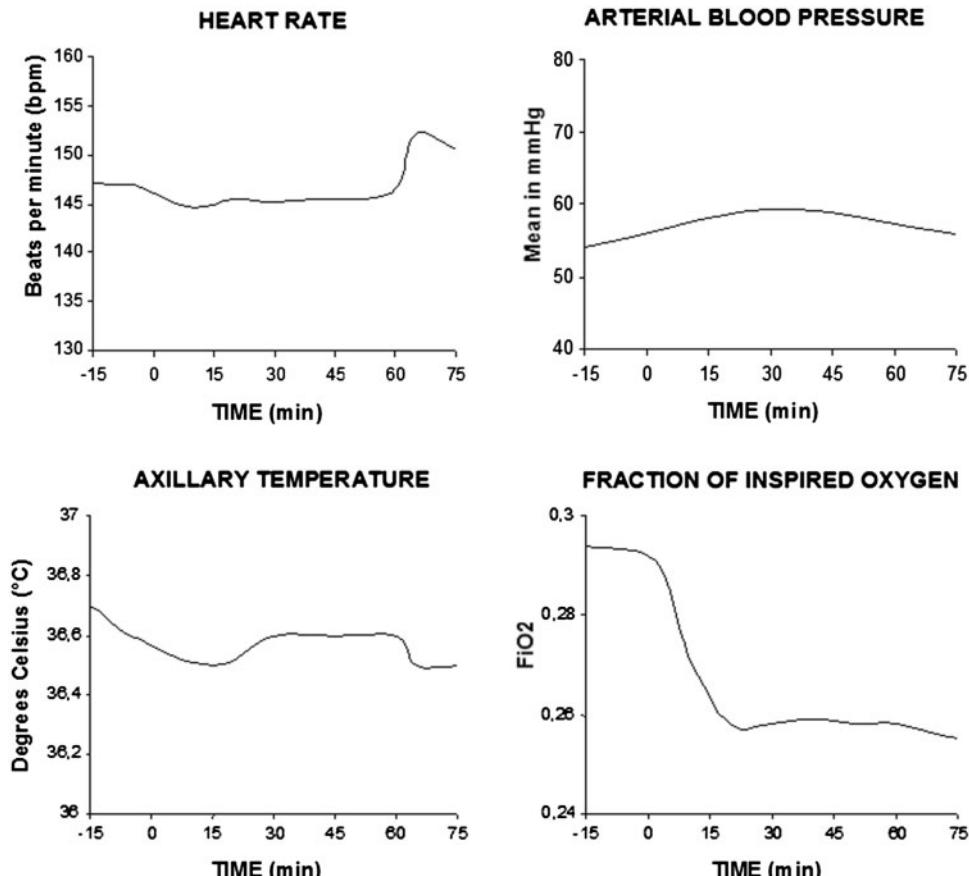


FIG. 1. Dependent variables.

with GA between 25 and 27 weeks in the first week during KMC.

There was a slight decrease in FiO_2 during KMC that was sustained after the procedure. The vertical position improves diaphragm efficiency and pulmonary function and favors oxygenation and cardio-respiratory stability [6, 14]. However, Smith [9] reported some instability in the physiological variables during KMC in 14 infants of very low weight (990 ± 155 g and corrected age of 30 ± 1 weeks) under MV diagnosed with bronchodysplasia. FiO_2 was significantly higher ($p = 0.009$) during KMC, especially in the second hour, and returned to the original values after 1 h in the incubator. SpO_2 was lower during KMC, but this was not statistically significant. It is important to point out that the variation in the measured parameters occurred mainly in the second hour of KMC, suggesting that KMC might not be safe in at-risk preterm infants for over 1 h.

Black [15] reported that reluctance, lack of protocols and team experience, as well as the fear of losing

venous access and accidental extubation, are obstacles for KMC in preterm infants under MV. In the present study, the team was properly trained in the hospital prior to the investigation, which probably prevented adverse events such as accidental extubation.

Early contact between mother and child is still not universally accepted in the assistance of preterm infants with weight < 1500 g and under MV. Changes in hospital practice are encouraged, but parents should also be guaranteed a satisfactory and gratifying relationship. Keeping the parents close to their infants in the first hours or days after birth seems to stimulate the operation of sensory, hormonal, physiological, immunological and behavioral mechanisms [16].

It would be beneficial in future studies to also collect data on neonatal head ultrasound and the impact of KMC on the mothers.

We conclude that despite the statistically significant differences in the vital signs in the moments before, during and after KMC, these variations

were clinically insignificant (lower than 5% from baseline) showing that KMC in this situation, especially when an able team exists, is probably safe and might bring benefits, especially with respect to mother-child bonding.

References

1. World Health Organization. Kangaroo Mother Care: A Practical Guide. Geneva: World Health Organization, 2003.
2. Ahn HY, Lee J, Shin HJ. Kangaroo care on premature infant growth and maternal attachment and postpartum depression in south-Korea. *J Trop Pediatr* 2010;56:342–4.
3. Zelkowitz P, Papageorgiou A, Bardin C, Wang T. Persistent maternal anxiety affects the interaction between mothers and their very low birthweight children at 24 months. *Early Hum Dev* 2009;85:51–8.
4. Ludington-Hoe SM, Morgan K, Abouelfetoh A. A clinical guideline for implementation of kangaroo care with premature infants of 30 or more weeks' postmenstrual age. *Adv Neonatal Care* 2008;8:3–23.
5. Worku B, Kassie A. Kangaroo mother care: a randomized controlled trial on effectiveness of early kangaroo mother care for the low birthweight infants in Addis Ababa, Ethiopia. *J Trop Pediatr* 2005;51:93–7.
6. Ludgington-Hoe SM, Ferreira C, Swinth J, Ceccardi JJ. Safe criteria and procedure for kangaroo care with intubated preterm infants. *J Obstet Gynecol Neonatal Nurs* 2003;32:579–88.
7. Gale G, Frank L, Lund C. Skin-to-skin (kangaroo) holding of the incubated premature infant. *Neonatal Netw* 1993;12:49–57.
8. van Zanten HA, Havenga AJ, Stigt HJH, et al. The kangaroo method is safe for premature infants under 30 weeks of gestation during ventilatory support. *J Neonatal Nurs* 2007;13:186–90.
9. Smith SL. Physiologic stability of Intubated VLBW infants during skin-to-skin care and incubator care. *Adv Neonatal Care* 2001;1:28–40.
10. Grunau RVE, Craig KD. Pain expression in neonates. *Pain* 1987;28:395–410.
11. Smith SL. Heart period variability of intubated very-low-birth-weight infants during incubator care and maternal holding. *Am J Crit Care* 2003;12:54–64.
12. Schrod L, Walter J. Effect of head-up body tilt position on autonomic function and cerebral oxygenation in preterm infants. *Biol Neonate* 2002;81:255–9.
13. Bauer K, Pyper A, Sperling P, et al. Effects of gestational and postnatal age on body temperature, oxygen consumption, and activity during early skin-to-skin contact between preterm infants of 25–30-week gestation and their mothers. *Pediatr Res* 1998;44:247–51.
14. Hunt F. The importance of kangaroo care on infant oxygen saturation levels and bonding. *J Neonatal Nurs* 2008;14:47–51.
15. Black K. Kangaroo care and the ventilated neonate. *Infant* 2005;1:127–32.
16. Klaus MH, Kennell JH. Parent-Infant Bonding. 2nd edn. St. Louis: C.V. Mosby, 1982.