



OUTCOME OF KANGAROO MOTHER CARE IN VERY LOW BIRTH WEIGHT BABIES.

Pediatrics

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ABSTRACT

Interventional stimulation of the preterm infant is one of Neonatology's new frontiers. The newborn is emerging as a distinct individual with feelings and responses and the significance of handling a human being in the process of developing is just being fully realized. The concept of 'nature and nurture' is well known. *The effects of nature are dependent on the quality of the 'nurture' provided during development and outcome of the nurture is dependent on the 'nature' of the organism (1).*

KMC is not simply the "poor man's" alternative. They are physiologically sound and emotionally appropriate interventions to the arena where the care for the fragile neonate is provided. These are not simply medical interventions, but the introduction of a set of human values, backed by scientific knowledge into the highly technical routine care of the youngest of our species.

KEYWORDS:

KANGAROO MOTHER CARE, KMC, VLBW

AIMS AND OBJECTIVES:

1. To study the effect of KMC on heart rate, temperature and oxygenation in babies 1800 g.
2. To compare the physiological parameters, temperature and morbidity in babies 1800 g between KMC and CMC.
3. To study the effect of KMC on the duration of hospital stay.
4. To study the acceptability of KMC in the mothers.

MATERIAL AND METHODS:

This study was conducted in a major tertiary care centre in a metropolitan city over a period of one year from 1st November 2000 to 31st October 2001. This centre has a level III Neonatal Intensive Care Unit with a delivery rate of approximately 7000 per year.

STUDY DESIGN: PROSPECTIVE RANDOMIZED STUDY

Inclusion criteria: All neonates fulfilling the following criteria were included in the study:-

- a) Apgar's score of 7 at 5 minutes.
- b) Birth weight 1800gms
- c) Stable vital parameters
- d) On feeds (breast feeds or spoon wati feeds with expressed breast milk.)

Exclusion criteria:

- a) Unstable babies requiring oxygen, vasopressors, ventilation, sick neonate.
- b) Babies on I.V. fluids.
- c) Perinatal asphyxia
- e) Major congenital malformations.
- f) Babies with birth weight > 1800 g.
- g) Refusal of parental consent.

Neonates, who fulfilled the inclusion criteria, were enrolled in the study. A written informed consent was taken from all the mothers, after which they were randomized by the sealed envelope method into two groups.

Group I = Kangaroo Mother Care (KMC)

Group II = Conventional Method Care (CMC)

Group I or KMC Group: KMC was given for a minimum of one hour at a stretch and continued for as long as comfortable to the baby and mother. At the onset of KMC, weight, heart rate, respiratory rate, axillary temperature (taken for 3 minutes) and oxygen saturations were noted.

The total numbers of desaturation ($\text{SaO}_2 < 85\%$) during KMC were noted. Heart rate was monitored continuously and mean readings were recorded every hourly. The episodes of bradycardia, as defined as heart rate less than 100 per minute, were noted.

The respiratory rates were counted hourly, when the infant was in quiet state and the mean was noted.

Axillary temperature was taken hourly for three minutes and episodes of hypothermia (temperature 36.0°C) and hyperthermia (temperature 38.0°C) were noted.

KMC was discontinued if infant demonstrated 'discomfort', crying, pushing out legs or the mother was uncomfortable. Wati spoon feeds were used in case they were unable to suck.

Any baby with problem during KMC was transferred to CMC and the indication for transfer was noted. After stabilization, baby was transferred back to KMC and mother continued to give KMC till discharge.

2) CONVENTIONAL METHOD CARE (CMC Group)

All babies assigned to CMC group were managed in open-care, overhead, radiant warmers. Babies were continuously monitored for oxygen saturations and the total number of desaturations (oxygen saturation $< 85\%$) was noted. Heart rate was continuously monitored and mean reading was recorded hourly. Respiratory rates were counted over one minute every hourly and the mean readings were noted.

The onset of breastfeeding was noted in both the groups. Babies in both the groups were discharged from the hospital when they met the following criteria.

- i) Weight-gain documented for at least three consecutive days.
- ii) Maintaining temperature without need for warmer care.
- iii) Feeding well on breast feeds or wati spoon-feeds.
- iv) Mother confident of taking care of the baby at home.

The total duration of hospital stay was recorded. Babies in the KMC group were advised continuation of KMC at home for as long as feasible.

At the time of discharge mothers were interviewed with a questionnaire as follows:

1. Assessment of satisfaction: Are you happy with KMC or would you prefer conventional method of infant care?

2. Assessment of comfort: Do you feel comfortable with KMC?
3. Will you continue KMC at home?
4. Does the father agree with mothers giving KMC?

Statistical Analysis:

Characteristics of infants included in the study were tabulated as averages (means) with standard deviation (SD). The KMC and CMC groups were compared on each parameter using 't' test (2-tailed unpaired) for parametric data and chi square test for non-parametric data.

For the physiologic parameters, the initial readings in the KMC and CMC group for each parameter (heart rate, respiratory rate and oxygen saturation) were compared with the average readings by unpaired, two tailed 't' test.

The analysis was done using the SPSS version 10 for windows. A 'p' value of <0.05 was considered as statistically significant and <0.001 as highly significant.

DISCUSSION:

Kangaroo mother care for low birth weight infants, originated in Columbia in 1978 and is defined as skin-to-skin contact between mother and baby, ensured by placing the infant in a strictly upright position on the mother's chest (*kangaroo position*). Kangaroo care can be used as an in-hospital intervention and continued at home under close ambulatory supervision until patient reaches the post-conceptional age of 40 weeks (8). Mothers are used as "incubators" and are the main source of food and stimulation for the baby.

Kangaroo mother care has been shown to be beneficial in low birth weight infants in a number of aspects. An attempt was made to scientifically prove some of these in a randomized controlled trial.

This is a randomized controlled study conducted in a level III NICU of a major teaching hospital in Mumbai from 1st November 2000 to 31st October 2001. A total of 89 babies who fulfilled the inclusion criteria were included and randomized into two groups. Kangaroo Mother Care (KMC) and conventional method care (CMC).

As regards the demographic characteristics in both the KMC and CMC groups, they were comparable for the gestational age, birth weight, antenatal risk factors and the modes of delivery. Higher proportion of babies 46.7% in KMC and 53.3% in control group (CMC) group were female.

97.7% of babies in the KMC group and 95.6% babies in the CMC group were preterms and this may be as a result of inclusion of babies below 1800gms in our study. The mean length and the head circumference of babies in both the groups were comparable. The type of milk and the method of feeding were similar in both the groups with more than 95 % of babies receiving exclusive breast feeds and the remaining were supplemented by banked Human milk.

Physiological parameters:

1. Heart rate: In the field of physiology, heart rate variability has been used as an estimate of neural control of the heart and as a peripheral manifestation of central nervous system function, especially information processing. A number of studies have been reported, studying the effect of KMC on heart rate some of which are summarized below:

Comparison of heart rate in CMC and KMC groups

Author	CMC	KMC	'p' value
Acolet et al	155±11.5	156.8±7.8	NS
Christenson et al	136.6±6.9	140±9	NS
Bohnhorst et al (median)	150(130-160)	156 (138-165)	<0.01
Present study	141.2±3.6	132.5±4.7	<0.001

(Ref. 9,10,11)

However in our study, babies in the KMC group had lesser heart rate (132.5 ± 4.7 per min as compared to the CMC group (141.2 ± 3.6 per min) and this was significant. The drop in the heart rate in babies with the KMC group may be due to the fact that both mother and the baby were observed to be calm and quiet, providing an environment that supported a quiet sleep state and thereby reducing the stress. Alfonso and colleagues and de Leeuw et al found no difference in the heart rate before, during and after skin-to-skin contact (12,13).

1. Oxygen saturation:

Acolet et al, Kaneko et al have shown a rise in the oxygen saturation in babies with skin-to-skin contact (9). Babies in the KMC group had significantly higher oxygen saturation as compared to the CMC group. These findings are in accordance with Acolet et al, Bier et al, Fohe et al (9,14,15).

Comparison of oxygen saturation in KMC and CMC groups

Author	CMC	KMC	'p' value
Acolet et al	94±2.2	95.5±2.0	NS
Fohe et al	93.9±3	94.3±2.7	<0.05
Legault et al	90.5	92.8	<0.001
Present study	94.8±0.7	95.7±1.1	<0.001

(Ref. 9,15,16)

3) Episodes of Desaturations: The total episodes of desaturations in the KMC were 85 out of 3596 recordings (2.36 %) and that in the CMC it was 96 desaturations out of 3490 recordings (2.75%) which were comparable. Bier et al made similar observations in which, there were 11% desaturations in the KMC group (191 out of 1716 recordings) and 24% desaturations in the CMC group (319 of 1334 recordings) and this was highly significant (14). The episodes of desaturation were markedly lower in our study and this was probably because of proper vertical position maintained in the KMC group with the use of the *dupatta*.

4) Respiratory Rates: Babies in the KMC group had significantly lesser respiratory rates as compared to CMC group and this has been confirmed by Wieland et al (18) Acolet (9), a possible explanation for this is based on upright position of the infant. Ventilation and perfusion are gravity dependent, so an upright position optimizes respiratory function thereby lowering the respiratory rates (13). Infants sleep more quietly in the KMC position, resulting in a more tranquil respiration (9,19,).

Temperature regulation: In mammals three different patterns of perinatal heat generation can be distinguished. The "immature" in which there is lack of thermoregulatory function, the "altricial" where the capacity for non-shivering thermogenesis is low or moderate at birth and the "precocial" with a fully developed capacity for heat production. The human infant is described as fitting in to altricial pattern of non-shivering thermogenesis (20). In this category, the mother protects her offspring by arranging a nest and by using her own body as a heat source. When holding the baby skin-to-skin and embracing it, the mother in a way similar to that of mother's of other altricial newborns.

During KMC, the infant is in contact with warm maternal skin on three sides. Bauer et al has shown that, there is increased rectal and peripheral skin temperature during skin-to-skin contact, which was not associated with increased energy expenditure (21).

Episodes of hypothermia were more common in CMC as compared with KMC (28 versus 11) and this was statistically significant and is similar to observations were made by Cattaneo et al (22) in which there were significantly more episodes of Hypothermia in the CMC group as compared to KMC group (14.6 versus 10.8) and Ludington-Hoe et al (23).

Hyperthermic episodes were more common in CMC group when compared with KMC, however this did not reach a statistical significance.

Morbidity:

1. Sepsis:

Preterm infants are at higher risk for infection because of epidermal barrier immaturity, poor defense mechanisms, interventions and procedures carried in the Neonatal intensive care unit (NICU). KMC also may help in reducing the incidence of nosocomial sepsis by means of exclusive breast feeding, which has specific factors such as immunoglobulins, lactoferrin and lysozyme. Skin-to-skin contact results in colonization of baby's skin with maternal flora to which antibodies are already transmitted transplacentally and through mother's milk.

2. **Apnea:** Apnea is one of the commonest problems encountered in the preterm infants. The incidence of apnea is inversely proportional to the gestational age. Bradycardia seen in apnea may be as a result of direct effect of hypoxia or as a peripheral chemoreceptor reflex response to falling oxygen saturation.

8 babies in the KMC had apnea as against 6 in the CMC and this difference was not statistically significant. Bornhorst et al also have demonstrated an increase incidence of apnea during KMC (11).

Several hypotheses have been put forth for the explanation of apnea. During KMC there is increased body temperature and increased episodes of bradycardia and hypoxemia may be associated with an elevated body temperature or ambient temperature. (24,25) Positional factors such as more neck flexion during KMC, would result in an increase in upper airway resistance, which can account for apnea (11).

Breastfeeding:

Breast feeding is a complex physiological event and its well known advantages such as provision of nutrients, immunological and anti-infective, anti-allergenic, gastrointestinal tolerance and digestive enzymes, emotional bonding and the passage of non-nutritional factors (hormones and growth factors) and long-term neuro-developmental benefits.

The babies in the KMC group had a trend to start breastfeeding earlier than those in the CMC group (4.75 days versus 5.62 days), however this difference was not statistically significant.

In developing countries, mother's milk is life saving because of relatively high cost of milk formulas and the risk of diarrhea from contaminated milk. In India KMC may be an important way of maintaining mother's precious lactation.

Duration of Kangaroo care:

In our study the mean duration of skin-to-skin contact was 9.83 hours per day with a standard duration of 3.68 hours. Following table shows the mean duration of the skin-to-skin contact in different studies.

Duration of skin-to-skin contact in various studies

Bauer et al	60 min.
Fohe et al	90 min.
Whitelaw et al	4 hours.
Tessier et al	22 hours.
Charpak et al	24 hours.
Paul et al	12 hours.
Present study	9.83 hours.

(Ref.21,26, 27,8,28)

Thus the duration of skin-to-skin contact in these studies was variable. However KMC should be carried as long as possible for both mother and baby.

Duration of hospital stay:

Babies in the KMC group showed a trend of shorter stay in hospital (8.58 days) than in the CMC group (9.32 days). This difference was not

statistically significant. This is in accordance with Cattaneo et al, Charpak et al, Paul et al, who observed earlier discharge in babies with KMC (8,22,28,29).

The weight at discharge in KMC group showed a higher trend than CMC group, however this was not statistically significant. This has been observed by Cattaneo et al, Charpak et al and the likely explanation would be frequent and exclusive breastfeeding, better thermal regulation, reduced energy expenditure during KMC, improved physiological parameters and reduced levels of stress which supports growth positively (22,8).

Transfer to CMC: A total of 15 babies were transferred from KMC to CMC group and the commonest indication was Hyperbilirubinemia (7 cases). Majority of babies were preterms and developed icterus requiring phototherapy but none required exchange transfusion. Sepsis was the second common reason for transfer of babies to CMC (6 cases), however the incidence of sepsis in the both the groups was comparable. Cattaneo et al observed the rate of transfer to be 13.4 %, which as much less as compared to our study and probably because the median age of enrolment was 10 days (1-74 days)(22), whereas in our study the mean age was 3.2 days (range 1-8 days).

Mortality:

The mortality in babies in both the groups was similar and there was no statistical difference

Interview with mothers:

All the mother's were interviewed by a questionnaire at the time of discharge to find out the acceptance of this new way of care in our country.

In our study, 86.36% mothers were happy with KMC and only 14.64% of mothers said that they would prefer conventional method. 79.45% of them were comfortable during KMC. The reason for discomfort in the remaining was the pain and the stress of labor. Our study is in accordance with Cattaneo et al (22), where 91% mothers were happy and 83% were comfortable. Though our sample size was small KMC was acceptable to most of the mother's. Similar observations have been made by Affonso et al and Paul et al (28).

72.72% of mother's felt that they would continue to give KMC at home and 63.63% of father's agreed to the mothers giving KMC. Thus Kangaroo care was accepted by most of the mothers in our study.

SUMMARY AND CONCLUSIONS:

Kangaroo mother care (KMC) when administered to 44 stable babies with birth weight 1800 g has been shown to have following effects in the study group (KMC) as compared to 45 babies in the CMC.

- Statistically significant decrease in the heart rate, respiratory rate in the KMC group (p value <0.001). This method has a calming effect on the baby, which supports a quiet sleep state or reduces the stress in the baby.
- Highly significant increase in oxygen saturation (p value < 0.001), which may be indicative of an improved physiological state of the infant during KMC.
- Significantly lesser episodes of hypothermia, which is related to the warm maternal skin and conductance of heat from mother to the baby.
- Trend towards lesser episodes of desaturations, earlier onset of breastfeeding, lesser episodes of hyperthermia.
- Trend towards decreased hospital stay in the KMC group when compared to the CMC group (8.58 days versus 9.32 days), however was not statistically significant
- 86.3 % of mothers felt comfortable during the KMC and 72.7 % felt they would be able to give KMC at home.
- KMC is a feasible and appropriate method of care in babies less than 1800gms in hospitals.

In conclusion, Kangaroo mother care when administered to stable babies weighing 1800 g showed beneficial effects on physiological parameters, temperature regulation and morbidity. CMC needs more space, expensive equipment, constant supply of oxygen and electricity, some of which may not be available in all parts of developing countries. KMC is more feasible, as mothers are already admitted in hospitals and are involved in the care of newborn. KMC is a safe alternative, as far as physiological parameters, thermal regulation and

morbidity is concerned when compared with CMC however under constant monitoring. This study has important implications in the care of LBW infants in the developing countries such as ours where expensive facilities for conventional care may not be available at all places.

Implications for research:

- More research is needed on the effectiveness and safety of KMC as a means to stabilize premature and LBW infants just after birth.
- Application of KMC in different settings (cultural and managerial barriers that may hinder its implications).
- Studies on KMC for the home care of LBW infants who are born at home and cannot be taken at hospitals.
- More evidence of advantages of KMC over other methods of care appear to be needed in LBW and premature infants with < 30 weeks post-conceptual age, critically ill neonates, ventilated neonates, < 1000g babies.
- Research is also needed on thermal control provided by skin-to-skin contact by a male member of family or a female who has not recently given birth.
- More information regarding effect of KMC on cost estimates of hospital stay are warranted.
- More studies on longer-term follow up of development of these infants would be desired.

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