

Pain Relief in Late Preterm Neonates: A Comparative Study of Kangaroo Mother Care, Oral Dextrose 50%, and Supine Nesting Position

Abstract

Objective: The objective is to compare the analgesic effect of Kangaroo Mother Care (KMC), oral dextrose 50% (D50) and supine nesting position in late preterm neonates (34 week to <37 week Gestation Age) while doing heel prick for blood glucose monitoring. **Materials and Methods:** Babies were randomized into three groups; KMC, D50 and supine nesting. Premature infant pain profile (PIPP) score was used to measure pain severity following heel prick. Total crying time was also compared. **Results:** Data of 149 eligible babies were analyzed; significant difference was noted in total PIPP scores (mean; SD) across groups; KMC (8.42 [1.99]), D50 (8.76 [1.84]) and nesting (13.08 [1.70]) ($P < 0.001$). *Post hoc* analysis revealed comparable scores among KMC and D50 groups ($P = 0.638$), significantly less than nesting group ($P < 0.001$). Significant difference in crying time (median; interquartile range) was also noted amongst three groups ($P < 0.001$). **Conclusion:** The analgesic effect of KMC and oral D50 is comparable and found to be superior to supine nesting position in reducing pain of heel prick.

Keywords: Heel prick, premature infant pain profile score, preterm neonate, procedural pain

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Introduction

Technological and scientific advances in neonatal units promote survival of preterm neonates. These babies often undergo painful procedures such as nasal, tracheal and gastric suction, heel punctures, venous or arterial catheterization and endotracheal intubation.

There is increasing evidence that pain or stress in preterm babies can cause long-term physiological and behavioral consequences by affecting sensory processes, neurobehavioral organization, and programming of the Hypothalamic-Pituitary-Adrenal axis.^[1,2]

Many clinical trials with varied outcomes have been published evaluating the effect of expressed breast milk (EBM), music therapy, oral sucrose, oral glucose, Kangaroo Mother Care (KMC), positioning on crib and parenteral or local analgesics for reducing procedural pain in neonates either alone or in combinations.^[3,4] In spite of documented efficacy and availability of these measures, they are not being used in clinical practice and routine procedures are done without offering any analgesia.^[5]

The present study has been undertaken to assess and compare the analgesic effect of KMC, oral dextrose 50% (D50) and supine nesting position in late preterm neonates undergoing painful procedure (heel prick for blood glucose monitoring). We chose late preterm in our study because it is comparatively less studied population than babies born more prematurely and requiring more intensive care.^[6]

Materials and Methods

This was a parallel, nonblinded randomized controlled trial conducted in NICU and postnatal ward of a tertiary care hospital from January 2017 to October 2018. Late preterm neonates (34 to 36 weeks of gestation as assessed by modified Ballard score) who required heel prick for blood glucose testing were enrolled after informed written parental consent. Neonates on inotropic support, sedatives, mechanical ventilator, had perinatal asphyxia (Apgar score <5 at 5 min), intra-ventricular hemorrhage or congenital malformations were excluded. The study was approved by the Institutional Ethics Committee (Ref

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no. PCMS/OD/2016/3159 dated 15.12.2016) and Clinical Trials Registry-India (CTRI/2017/11/010612).

Sample size was calculated based on a previous study, where the mean difference of premature infant pain profile (PIPP) score was 1.62 between two groups. Considering the standard deviation (SD) of 1.6 in group 1 and 1.8 in group 2 with 1% level of significance and 90% power, minimum of 39 subjects were supposed to be recruited in each arm.^[7] Enrolment of 50 babies in each of three arms was planned initially to compensate for the loss of babies fulfilling the exclusion criteria. Late pre-term babies born in the hospital during study period were randomized into three groups; who received KMC (started at least 30 min before intervention), oral D50 (0.5 ml/kg solution administered slowly by sterile syringe 2 min before heel prick) or supine nesting position (position given by linen/towels lying in crib). Computer-generated random numbers in sealed opaque envelope were used for group allocation in 1:1 ratio. Faculty involved in the study opened the sequentially numbered envelopes and did group allocation while resident enrolled the participants and recorded the data. Nursing staffs were trained for helping mothers in KMC, administering oral dextrose solution, putting the baby in nesting position and time recording with the help of stopwatch.

Heel prick was done using a lancet (Autolet) with fixed depth of puncture (1.0 mm) to obviate the difference in the strength of painful stimuli. After pricking the heel, severity of pain was assessed by using PIPP score.^[8] Primary outcome measured was severity of pain after heel prick using PIPP scale while secondary outcome measured was total crying time (starting from time of prick to when baby stops crying) following the prick. The study ended once requisite number of patients has been enrolled.

Premature infant pain profile tool

PIPP score is a composite pain measure that includes contextual (behavioral state and gestational age), facial action (brow bulging, eye squeezing, and nasolabial furrowing) and physiologic (heart rate and oxygen saturation) indicators of pain. Behavioral state was scored by observing infant's activity, status of eye (eyes open or closed) and facial movements for 15 s before heel prick. Baseline heart rate and oxygen saturation was recorded. Following the prick, the baby was observed for 30 s for facial changes and physiological parameters (maximum HR and lowest SpO₂) and scores were recorded immediately.

Statistical analysis

Data were analyzed for the normality by Shapiro-Wilk test. Analysis of variance (ANOVA) was used to compare means and Kruskal Wallis test to compare medians of multiple groups. For mean/median which was found significant, *post hoc* analysis was performed using Tukey

test to compare the difference in all possible pairs of data. Categorical data were compared using Chi-square test. Level of significance was assessed at 5% ($P < 0.05$). Data analysis was performed using IBM - SPSS (version 20, Chicago, SPSS Inc.).

Results

In this prospective randomized controlled trial, 160 eligible neonates were randomized into 3 groups (KMC, D50 and nesting). During analysis, 11 neonates were excluded due to incomplete data (neonates who started crying before prick or needed double prick). Final analysis was done on 149 neonates. Flow diagram for enrollment of babies is given in Figure 1. Baseline characteristics of babies in three groups were found to be comparable except basal HR which showed significant reduction in KMC group ($P < 0.001$) [Table 1].

ANOVA test revealed a significant difference in mean (SD) of total PIPP score across groups; KMC (8.42 [1.99]), D50 (8.76 [1.84]) and nesting (13.08 [1.70]) ($P < 0.001$). *Post hoc* analysis revealed a comparable score ($P = 0.638$) between KMC and D50 groups. However, when scores of KMC and D50 groups were compared individually with supine nesting group, they were found to be significantly less ($P < 0.001$). Significant difference was observed in all the individual components of PIPP scores across three groups [Table 2].

Kruskal-Wallis test showed a significant difference in median (interquartile range [IQR]) of total crying time across three groups ($P < 0.001$). *Post hoc* analysis showed that KMC and D50 groups had comparable total crying time (128 [100–180] s) versus (130 [110–180] s) ($P = 0.895$) which was significantly less than nesting group (197 [158–268] s) ($P < 0.001$).

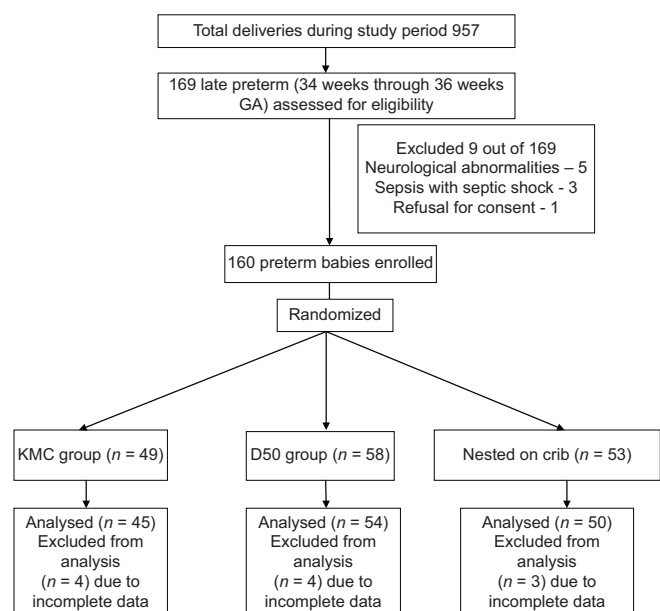


Figure 1: Flow diagram for enrollment of neonates

Table 1: Comparability of baseline characteristics of neonates after randomization in three study groups

Intervention	GA (weeks), median (IQR)	Gender		Basal HR, median (IQR)	Basal SpO ₂ , median (IQR)
		Female	Male		
KMC (n=45)	36 (34-36)	22	23	121 (110-148)	96 (94-99)
D50 (n=54)	36 (34-36)	23	31	138 (120-161)	96 (92-98)
Nesting (n=50)	35 (34-36)	22	28	141 (110-168)	96 (92-98)
<i>P</i>	0.744	0.810		<0.001	0.663

IQR: Interquartile range, HR: Heart rate, GA: Gestational age, KMC: Kangaroo mother care, D50: Dextrose 50%, SpO₂: Oxygen saturation

Table 2: Evaluation of behavioral and pain indicators before and after heel prick

	KMC (n=45)	D50 (n=54)	Nesting (n=50)	<i>P</i>
GA	0.0 (0-1)	0.0 (0-1)	1.0 (0-1)	0.868
Behavioral score	2.0 (0-3)	1.0 (0-3)	0.0 (0-3)	<0.001
Maximum rise in HR	1.0 (0-3)	1.0 (0-2)	2.0 (1-3)	<0.001
Fall in SpO ₂	0.0 (0-2)	1.0 (0-2)	1.0 (0-3)	<0.001
Brow bulge	2.0 (1-3)	2.0 (1-3)	3.0 (2-3)	<0.001
Eye squeeze	2.0 (1-3)	2.0 (1-3)	3.0 (2-3)	<0.001
Nasolabial furrow	2.0 (1-3)	2.0 (1-3)	3.0 (2-3)	<0.001

*All the values are in median (IQR). GA: Gestational age, HR: Heart rate, KMC: Kangaroo mother care, D50: Dextrose 50%, SpO₂: Oxygen saturation

Discussion

In the present trial, 149 eligible neonates were analyzed in three groups (KMC, D50 and supine nesting) for assessing the severity of pain in response to heel prick. Their baseline characteristics were found to be comparable except slow HR in KMC group. This is explained by positive effect of KMC on the baby's physiological parameter. KMC and D50 were found to be equally effective in reducing pain with comparable total PIPP score ($P = 0.638$) against higher score in nesting group ($P < 0.001$). Similarly, total crying time was significantly more in nesting group ($P < 0.001$) than KMC and D50 groups which were comparable to each other ($P = 0.895$).

It is well known that KMC reduces pain by calming the baby, reducing stress, releasing oxytocin, reducing autonomic pain responses and blocking transmission of nociceptive stimuli by providing continuous tactile stimulation (Gate Control Theory).^[9] Its analgesic effect has been demonstrated by earlier studies.^[10,11] Combination of skin-to-skin contact and oral 25% dextrose treatment can act synergistically to decrease acute pain in healthy neonates.^[12] It is shown that KMC alone is less effective in reducing pain as compared to KMC combined with EBM and music.^[13]

The analgesic effect of dextrose is due to oro-gustatory effects of sweet solution and endogenous opioid pathway.^[14] The present study used glucose water instead of sucrose solution because it is easily available in NICU and was found to be equally effective analgesic in neonates.^[15]

To determine the optimum concentration of glucose to be used as analgesic, a recently published study confirmed that 40% dextrose solution effectively relieved pain in full-term

newborns without causing hyperglycemia while 10% and 20% dextrose solutions did not affect neonatal pain scores.^[16] On comparing the analgesic effect of oral glucose with EBM, glucose was found to be superior.^[7,17]

While the present study found KMC and oral dextrose equally effective as analgesic, Freire *et al.* demonstrated higher pain relieving effect in the KMC group as compared to prone position in incubator and oral glucose groups.^[18]

The importance of positioning for the well-being of the infant has been documented.^[19] Nesting position maintains the flexion posture which is an intrauterine position also. It supports infants in mid line, facilitate sleep, support development of sensory systems and can be used as a nonpharmacological measure to reduce pain during painful procedure. Although in the present study, supine nesting position was used, a recent review on NICU positioning strategy emphasized on prone nesting position to be superior in relieving stress.^[20] Contrary to this, another study showed no significant difference between prone and supine positions.^[21]

Nonblinded in nature, scoring by PIPP scale in real time as opposed to videotaping for subsequent analysis and assessment of PIPP score by single observer with no inter-rater reliability check were few limitations of the present study.

Conclusion

The present study concludes that KMC and oral dextrose 50% are equally effective and superior to supine nesting position in reducing pain response in late preterm neonates during heel prick. Therefore, either can be used routinely in NICU and postnatal wards to reduce procedural pain.

Ethical committee clearance

Institutional Ethics Committee on 15.12.2016 Ref no. PCMS/OD/2016/3159.

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Conflicts of interest

There are no conflicts of interest.

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