

Effectiveness of Kangaroo Mother Care in Reducing Pain during Minor Procedures in Preterm Neonates

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ABSTRACT

Introduction: Premature babies admitted in Neonatal Intensive Care Unit (NICU) are subjected to many painful invasive procedures. The exposure to pain leads to immediate and long term changes in the structure and function of preterm newborn's brain and therefore pain must be avoided in neonates to prevent the adverse effects. Kangaroo Mother Care (KMC) is one of the effective non pharmacological methods of reducing neonatal pain for minor procedures.

Aim: Evaluate the effectiveness of KMC versus conventional care in reducing pain in premature neonates during minor procedures.

Materials and Methods: Prospective study done in a Tertiary Care Hospital over eighteen months. Eighty premature neonates with gestational age between 28 to 37 weeks and birth weight <2000 grams, requiring venepuncture for blood collection were included and alternately allocated into study and control group. Preterm neonates in KMC (study) group

were given kangaroo care for 30 minutes uninterrupted prior to and throughout the venepuncture procedure and this was followed by at least 10 minutes KMC after the procedure. Neonates in control group receiving conventional care were placed in a cradle 30 minutes before, during and after venepuncture procedure. In all these neonates, pain assessment was done, using the Premature Infant Pain Profile (PIPP) score which was estimated at one minute prior and 1, 3, 5 minutes after the venepuncture procedure.

Results: Mean PIPP scores in study (KMC) group at 1, 3 and 5 minutes after procedure were less than mean scores in control group and this difference between the scores was statistically significant ($p < 0.001$).

Conclusion: Our study revealed that KMC is an effective non pharmacological and safe modality in reducing pain in premature neonates during minor painful procedure like venepuncture as compared to conventional care.

Keywords: Premature infant pain profile, Procedural pain, Skin to skin contact

INTRODUCTION

Neonates admitted in NICU are usually exposed to various painful procedures, without receiving appropriate pain medication. This was primarily due to earlier misconceptions like, the nervous system in these babies is immature and so they do not feel pain. Recent studies have revealed that neonates can also perceive pain like adults [1]. According to the researchers, the basic connections in pain pathways are formed well before birth and so a human foetus is able to perceive nociceptive stimuli even before 30 weeks of gestation [2]. Exposure to prolonged or severe pain causes increased stress in neonates with immediate physiological effects like increased oxygen consumption, decreased nutrient intake, altered sleep and wakefulness while in the long term these babies are more prone to adverse neurodevelopmental outcome and altered response to subsequent painful stimuli [3-6].

KMC or skin to skin contact involves holding diaper clad neonates upright between mother's breasts and is well known for several benefits including promoting breastfeeding, early weight gain, early bonding and providing thermal control [7]. KMC also helps in maintaining physiological stability in neonates and reduces pain responses in them [6,8]. Hence, we planned to study KMC as a tool versus conventional care for reducing pain in premature neonates during minor procedures so as to promote its extensive use for the same.

MATERIALS AND METHODS

The present study was a single centre prospective study to determine the effectiveness of KMC in reducing pain in premature neonates admitted to the NICU of a major tertiary care teaching hospital during venepuncture, a minor painful procedure. This study was conducted over a period of 18

months and prior approval by the institutional ethics committee was taken. Before enrolling the subjects, written consent was taken from the parent/care taker.

Sample Selection

Eighty premature neonates with gestational age between 28 to 37 weeks and birth weight <2000 grams, whose general condition was stable and were on breastfeeding, cup feeding or on orogastric tube feeding and required venepuncture for blood collection were included and alternately allocated into study and control group. Both intramural and extramural babies fitting in inclusion criteria were included in study. Neonates with gestational age <28 weeks or >37 weeks or with birth weight <500 grams, very sick/physiologically unstable and those requiring ventilator support were excluded from study.

Data Collection and Procedure

Detailed information regarding neonates including maternal history and clinical findings were recorded. The included neonates underwent venepuncture procedure for various investigations, which was performed using 24 gauge needle by one of the experienced paediatric resident doctor. Baseline behavioural state was scored of all the babies in both the study and control group, one minute prior to the procedure for 30 seconds using PIPP scoring, which is a validated behavioural measure of pain for premature infants [9]. Scores of 0-6 indicate that infant has minimal or no pain, scores of 7-12 indicate slight to moderate pain while scores >12 may indicate severe pain.

This scoring system includes assessment of following parameters: gestational age, behavioural state, change in heart rate, change in oxygen saturation, brow bulge, eye squeeze, nasolabial furrow. Baseline heart rate and oxygen saturation was determined using pulse oximeter.

Preterm neonates in the study group, received KMC (KMC group) for 30 minutes uninterrupted prior and throughout the venepuncture and for at least 10 minutes after the procedure. KMC was given by placing the neonate in direct skin to skin contact over the mother's chest between the breasts. PIPP

score estimation was done one minute prior and 1,3,5 minutes after the procedure. However, the neonates in control group, received conventional care and were placed in a cradle 30 minutes before, during and after venepuncture procedure and they did not receive any KMC care. In these neonates too, PIPP score estimation was done one minute prior and 1,3 and 5 minutes after the venepuncture procedure.

STATISTICAL ANALYSIS

Data analysis was done with the help of SPSS software version 15.0 and sigma plot version 11.0. Quantitative data was presented with the help of mean, standard deviation and median. Comparison between study groups was done with the help of Unpaired 't'-test or Mann-Whitney test as per results of Normality test and also Chi-square test. The p-value less than 0.05 was taken as significant level.

RESULTS

The demographic profile of neonates in our study and control groups was similar. There was a slight male preponderance (M:F-1.2:1) which was statistically not significant. Birth weight of neonates ranged between 1 to 2 Kg, with 27.5% weighing <1.5 Kg and 72.5% belonged to 1.5-2 Kg category. The gestation agewise distribution of neonates revealed that majority of the neonates (58.7%) belonged in the gestation band between 34-37 weeks. The neonates enrolled for our study were, admitted in the NICU, either for, preterm care (40%), sepsis (12%), hyperbilirubinaemia (10%), pneumonia (4%), polycythemia, congenital heart disease, Hyaline Membrane Disease (HMD) or hypoglycaemia.

All the neonates included in study had similar baseline behaviour as suggested by PIPP score which was zero (no pain) and a few had very minimal pain (less than 6) at one minute prior to procedure. The overall comparisons between study and control group PIPP scores at 1,3 and 5 minutes after venepuncture procedure are depicted in [Table/Fig-1]. This table revealed that majority of study group (KMC group) had moderate pain with PIPP score between 7-12 (77.5% of cases) at one minute after

PIPP Score	Number of Neonates							
	1 min before procedure		1 min after procedure		3 min after procedure		5 min after procedure	
	Study	Control	Study	Control	Study	Control	Study	Control
0-6 No or Mild Pain	40 (100%)	40 (100%)	2 (5%)	-	16 (40%)	1 (2.5%)	35 (87.5%)	3 (7.5%)
7-12 Mild to Moderate Pain	-	-	31 (77.5%)	3 (7.5%)	22 (55%)	9 (22.5%)	5 (12.5%)	33 (82.5%)
>12 Severe Pain	-	-	7 (17.5%)	37 (92.5%)	2 (5%)	30 (75%)	-	4 (10%)
Pearson's Chi-square test								
Value	-		45.513		43.187		51.579	
Df			2		2		2	
p-value	-		<0.001		<0.001		<0.001	

[Table/Fig-1]: Overall comparison of PIPP score in study and control group.

Gestation Age Band	PIPP Score*	Number of Neonates							
		1 min before procedure		1 min after procedure		3 min after procedure		5 min after procedure	
		Study	Control	Study	Control	Study	Control	Study	Control
<32 Weeks (n=4)	0-6	3 (100%)	1 (100%)	-	-	1 (33.3%)	-	3 (100%)	-
	7-12	-	-	3 (100%)	1 (100%)	2 (66.7%)	1 (100%)	-	1 (100%)
	>12	-	-	-	-	-	-	-	-
32-33 Weeks (n=29)	0-6	21 (100%)	8 (100%)	2 (10%)	-	8 (38%)	1 (13%)	18 (86%)	2 (25%)
	7-12	-	-	15 (71%)	-	13 (62%)	1 (13%)	3 (14%)	6 (75%)
	>12	-	-	4 (19%)	8 (100%)	-	6 (74%)	-	-
34-37 Weeks (n=47)	0-6	16 (100%)	31 (100%)	-	-	7 (44%)	-	14 (88%)	1 (3%)
	7-12	-	-	13 (81%)	2 (6%)	7 (44%)	7 (23%)	2 (12%)	26 (84%)
	>12	-	-	3 (19%)	29 (94%)	2 (12%)	24 (77%)	-	4 (13%)

[Table/Fig-2]: Comparison of PIPP score in study and control group according to gestational age band.

*PIPP Score: 0-6-No or Mild pain, 7-12- Mild to Moderate pain, >12 Severe pain

Birth Weight Category	PIPP Score*	Number of Neonates							
		1 min before procedure		1 min after procedure		3 min after procedure		5 min after procedure	
		Study	Control	Study	Control	Study	Control	Study	Control
1000-1500 gm (n=22)	0-6	17 (100%)	5 (100%)	1 (6%)	-	7 (41%)	-	14 (82%)	2 (40%)
	7-12	-	-	11 (65%)	2 (40%)	10 (59%)	3 (60%)	3 (18%)	3 (60%)
	>12	-	-	5 (29%)	3 (60%)	-	2 (40%)	-	-
1501-2000 gm (n=58)	0-6	23 (100%)	35 (100%)	1 (4%)	-	9 (39%)	1 (3%)	21 (91%)	1 (3%)
	7-12	-	-	20 (87%)	1 (3%)	12 (52%)	6 (17%)	2 (9%)	30 (86%)
	>12	-	-	2 (9%)	34 (97%)	2 (9%)	28 (80%)	-	4 (11%)

[Table/Fig-3]: Comparison of PIPP score in study and control group according to weight category.

*PIPP Score: 0-6-No or Mild pain, 7-12- Mild to Moderate pain, >12 Severe pain

the procedure, whereas about 92.5% neonates had severe pain (PIPP>12) in the control group (conventional care) and this difference was highly significant ($p<0.001$). At three minutes after venepuncture procedure, only 5% had severe pain in the study group in contrast to 95% still having severe pain in the control group which was statistically highly significant ($p<0.001$). Neonates in different gestational age bands (32-33 weeks and 34-37 weeks) also revealed a statistically significant ($p<0.001$) higher PIPP score in the control group as compared to neonates in the study group [Table/Fig-2]. Since, the number of babies less than 32 weeks were very few (four neonates) the statistical difference in the study and control group could not be commented upon. On reviewing the PIPP scores in the different birth weight categories, this too revealed that the PIPP scores were statistically higher in control group than study group subjects [Table/Fig-3].

Mean PIPP scores in study group one minute before procedure and 1, 3, 5 minutes after procedure were 3.37, 10.8, 7.7 and 4.37 respectively; while corresponding scores in control group were 3.4, 15.57, 13 and 10.3 respectively. Mean PIPP scores in study group 1, 3 and 5 minutes after procedure were less than mean scores in control group [Table/Fig-4]. This difference

Mean PIPP Scores				
	1 minute before procedure	1 minute after procedure	3 minute after procedure	5 minute after procedure
Study	3.37	10.80	7.70	4.37
Control	3.40	15.57	13.00	10.30
Mann-Whitney Test	0.101	6.882	6.873	6.928
p-value	0.920	<0.001	<0.001	<0.001
Significance	Not Significant	Significant	Significant	Significant

[Table/Fig-4]: Mean PIPP scores in study and control group.

between the scores was also statistically highly significant ($p<0.001$).

DISCUSSION

Premature babies admitted in the NICU often stay for several weeks and usually undergo many painful minor invasive procedures like heel prick, venepuncture, orogastric tube insertions, endotracheal intubations and central catheter insertions. Often these procedures are not adequately covered with pain relief measures. There is increasing evidence that pain/

stress in premature babies causes behavioural, physiological and long term consequences that affect the sensory processes, neurobehavioral organisation and programming of the Hypothalamic-Pituitary-Adrenal (HPA) axis [2,4,5,8,10,11]. Therefore, one of the primary goals in the NICU should be to minimise procedural pain in neonates.

Numerous pharmacological and non pharmacological modalities have been used to reduce pain in minor procedures [8,11]. Pharmacological drugs/analgesics like opioids, acetaminophen and topical anaesthetics are not very effective in newborns, have many side effects and their safety is not well studied in newborns [12,13]. Non pharmacological measures include breastfeeding, swaddling, KMC, pacifier, music, rocking, massage and touching have been tried in the neonates [14]. There are various studies that have revealed the consistent efficacy of KMC in reducing pain during minor invasive procedures. Meta-analysis done by Boundy EO et al., on KMC revealed better neonatal outcome in terms of morbidity like decreased rates of sepsis, hypoglycaemia, hypothermia and improved rates of breastfeeding. Also, neonates who were instituted KMC had improved physiological signs and lower PIPP scores after painful stimuli [15].

Kangaroo care and most non pharmacological methods appear to contribute to reducing pain in neonates by several mechanisms like by calming the baby, reducing the level of stress, oxytocin release and causing blockade of the transmission of nociceptive stimuli by providing continuous tactile stimulation (Gate Control Theory) [12,16-19]. As per this theory the multisensory competing stimuli travelling the ascending pathways inhibit the noxious painful stimuli through endogenous mechanisms located along the spinothalamic tracts [12,20].

Study done by Bellieni CV et al., revealed that even routine painful procedures were harmful to the newborns as pain caused oxidative stress and release of free radicals which are harmful to the developing brain of neonates [6]. According to the study done by Kostandy R et al., KMC also reduces infant's crying response and thereby reduces adverse physiological effects like increased heart rate and blood pressure [16].

In our study, the mean PIPP scores in study group (that was given KMC) at 1 minute after, 3 minutes after and 5 minutes after venepuncture procedure were lower as compared to control group, where no KMC was given. These findings are consistent with many of the previous studies found in literature. Akcan E et al., in comparative, randomized, controlled study, aimed to evaluate the effect of KMC also had very similar results of lower PIPP scores in the KMC group [14]. Researchers like Johnston CC et al., in their cross-over trial on pain from heel lance in preterm and very preterm babies showed lower PIPP scores in the neonates receiving kangaroo care [18,21].

In the present study we only studied the PIPP scores using the kangaroo care modality in isolation as compared to study by Freire NB et al., who studied the analgesic effect of skin to skin contact compared to oral glucose in preterm neonates [8]. This study revealed better physiological parameters and lower PIPP scores in the group receiving kangaroo care in comparison to the glucose and incubator groups. Dezhdar S et al., in their randomised clinical trial on comparison of KMC and swaddling intervention on venepuncture pain in premature neonates showed that KMC and swaddling both reduced pain as compared to neonates in control group [20].

Various studies done in Indian set up have found the effectiveness of KMC in reducing heel prick pain and their findings of PIPP scores were very similar to our study [10,11,13,22,23]. In our study we found that the preterm infants were benefited by the kangaroo care irrespective of their gestational age band and birth weight. This study adds that even short duration (30 minutes) of KMC prior to a minor invasive procedure in preterm neonates is effective in reducing pain.

LIMITATION

We enrolled only clinically stable neonates who had undergone low intensity stimulus caused by venepuncture and the study was not blinded.

CONCLUSION

Our study indicates that kangaroo care is a non pharmacological cost effective and safe intervention reduces pain in premature neonates during minor painful procedures in comparison to conventional care.

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