

A Comparative Study of Non-Pharmacological Methods to Reduce Pain in Neonates

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Manuscript received: June 27, 2005; Initial review completed: September 20, 2005; Revision accepted: July 19, 2006.

A randomized study was done to compare non-pharmacological methods to reduce the pain of heel pricks in 104 stable term neonates. Non-nutritive sucking (NNS), rocking, massage, sucrose (20%), distilled water (DW) and expressed breast milk (EBM) were used as pain-reducing agents. Duration of cry and Douleur Aiguë du Nouveau-né (DAN) score were used to assess pain. Physiological parameters were also recorded before and after the stimulus. At 30 seconds after the stimulus, the pain scores were lowest in the sucrose group but this was not sustained at 1, 2 and 4 minutes. At 2 and 4 minutes pain scores were lowest in the NNS and rocking groups as compared to sucrose, distilled water, expressed breast milk and massage. The total duration of crying was also lowest in the NNS and rocking groups. Physiological parameters were comparable in all groups. Babies who were in Precht State 1 and 2 (sleeping) at the time of stimulus showed significantly lesser response to pain compared to babies who were awake. This was seen in all the intervention groups. In conclusion, our study suggests that rocking or giving a baby a pacifier are more effective non-pharmacological analgesics than EBM, DW, sucrose or massage for the pain of heel pricks in neonates. A calm or sleeping state before a painful procedure also appears to decrease crying and pain scores.

Key words: Neonates, Non-pharmacological analgesia, Pain.

DESPITE an increasing awareness regarding pain in neonates and its detrimental effect on neurobehavioral development(1,2), newborns continue to be subjected to procedural pain without analgesia. Lack of adequate training of health care personnel, the inability of neonates to express themselves and fear of the side effects of analgesics are some of the reasons why this happens(3). Pain perception is associated with physiological and complex behavioral changes in neonates in the form of immediate alteration in state of arousal, disruption of adaptation to the environment and changes in vital parameters. Crying and changes in facial expression are common manifestations of

pain(4). Heel prick, for capillary sampling, is one of the most frequently performed procedures in the neonatal nursery and postnatal ward. The sharp, acute pain that it produces is more than that of a venepuncture and can be very distressing to the neonate(5).

In the past few years there have been a number of studies to determine simple measures to reduce pain in neonates. Non-pharmacological methods are feasible, acceptable and easy to use. Though they have all shown promise, no single method is universally recommended. This study was done to objectively compare some of these methods with the intention of deciding which was the

best one to incorporate into the Unit's policy on pain management.

Subjects and Methods

(a) The study was carried out in the Transitional Care Unit and Postnatal Ward of a large, teaching hospital. This was a randomized study on 104 term neonates, who underwent heel prick for collection of blood for bilirubin estimation. Term babies older than 24 hrs of life were included. Those excluded were babies <2 Kg sick babies with unstable vitals or on IV fluids, oxygen or any drugs requiring resuscitation at birth, with neurological abnormalities, or having major congenital defects.

Outcome variables

- (a) Time of first cry (till the baby took the first inspiration after starting to cry) and total duration of cry were measured after the stimulus.
- (b) Heart rate and SpO₂ were recorded before giving the stimulus and at 2 and 4 minutes after the stimulus.
- (c) DAN score was assessed before giving the stimulus and again at 30 sec, 1 min, 2 min and 4 min after the stimulus.

Sample size estimation

Sample size was calculated to show a decrease of at least 20% in the mean DAN score after any intervention compared with no inter-vention.

Randomization

Subjects were randomized (using random number table) to receive one of the following 6 interventions: Expressed Breast Milk (EBM); Sucrose (20% S); Distilled Water (DW); Non Nutritive Sucking (NNS); Massaging (M); and Rocking (R).

Intervention

Parents were explained the procedure and informed consent was taken. The baby was placed naked in a cot under a radiant warmer in a quiet, diffusely lighted room. The pulse oximeter probe was attached firmly to the hand. All interventions were kept ready for every baby.

Blinding was achieved by one of the observers (Observer 1) leaving the bedside at this stage and standing behind a screen. The baby was then assigned to one of the groups. A trained nurse gave the selected intervention two minutes before the heel prick as follows:

EBM, 20% sucrose or distilled water were administered (2ML) in the baby's mouth with a dropper. In NNS group, a sterile pacifier (standard silicone pacifier) was held gently in the neonate's mouth and the palate tickled to stimulate sucking. This was continued during and up till 2 minutes after the heel prick. In M group, neonates were subjected to firm, gentle stroking with bare fingers in a rhythmical manner starting from the forehead and going down to the chest, arms and legs. 6 strokes were given in each area and these were continued in a cyclical manner during and up till 2 minutes after the heel prick. In R group, neonates were rocked by lifting the baby's head off the cot on the palm of the hand (without lifting the body off the cot) and making rocking movements in a gentle, rhythmic manner. This was continued during and up till 2 minutes after the heel prick.

Data Collection

Two minutes after commencement of the intervention, just before the heel prick, Observer 2 evaluated the Prechtl's State of arousal, HR and SpO₂. Baseline DAN score (Table I) was also recorded. A trained nurse

then gave the heel prick in a standard manner with a lancet. Three nurses who were trained in giving effective heel pricks did the sampling all through the study. Squeezing was done not more than 3 times to collect the sample. The duration of first cry (time to first inspiration after commencement of cry) and total duration of cry were recorded by Observer 1 who was blinded to the intervention. Observer 2, who was not blinded, assessed the DAN score again at 30 sec, 1 min, 2 min and 4 min after the prick. Heart rate and SpO₂ were also recorded from the pulse oximeter at 2 and 4 minutes.

Statistical analysis

Data was analyzed using SPSS ver 11.5. ANOVA followed by Fischer's exact 't' test where required. Multivariate analysis was used

for demographic data. Pearson's correlation test was used where required.

Results

The demographic characteristics were similar in all the groups (*Table II*). When DAN scores were compared, this was lowest at 30 sec in the sucrose group but was not sustained at 2 and 4 minute. At these times the scores were lowest in the NNS and rocking groups (*Table III*). The total duration of cry was lowest in these two groups as well (*Table IV*). There was no significant difference in physiological parameters between the groups. As regards the state of arousal, babies in states 1 and 2 showed significantly lower pain scores at all times (*Fig. 1*). Duration of cry also correlated well with state of arousal at the time of painful

TABLE I—Douleur Aiguë du Nouveau-né (DAN) Behavioral Scale

Item	Score
Facial expression	
Calm	0
Snivels and alternates gentle eye opening and closing	1
Intensity of eye squeeze, brow bulge, nasolabial furrow:	
Mild, intermittent with return to calm	2
Moderate	3
Very pronounced, continuous	4
Limb movements	
Calm or gentle movements	0
Intensity of pedaling, toes spread, legs tensed and pulled up, agitation of arms, withdrawal reaction:	
Mild, intermittent with return to calm	1
Moderate	2
Very pronounced, continuous	3
Vocal expression	
No complaints	0
Moans briefly (for intubated child, looks anxious or uneasy)	1
Intermittent crying (for intubated child, expression of intermittent crying)	2
Long lasting crying, continuous howl (for intubated child, expression of continuous crying)	3

TABLE II—Demographic Characteristics of Different Groups (± 2 SD)

	EBM	Sucrose	DW	NNS	Massage	Rocking	P value
Total	N=18	N=17	N=15	N=20	N=17	N=17	NS
Males (%)	8(44.4)	7(41.1)	7(46.6)	11(55)	9(52.9)	10(58.8)	NS
Females (%)	10(65.6)	10(58.9)	8(53.4)	9(45)	8(47.1)	7(41.2)	NS
Mean age (hrs) (± 2 SD)	46.5 (2.1)	48 (2.3)	44 (1.9)	45.5 (2.2)	44 (2.2)	46 (2.7)	NS
Mean birth weight (%) (± 2 SD)	2991.7 (312.2)	2953 (289.2)	3026.7 (301.7)	2994 (289.7)	3123 (301.6)	2995 (299.7)	NS
Vaginal delivery (%)	15(83.3)	12(70.5)	11(73.3)	16(80)	14(82.3)	12(70.5)	NS
Mean time since last feed (min)	25.28	35	38.33	31	35.3	35.5	NS
No of babies in state of arousal >2 at stimulus	6	7	7	6	8	5	NS

TABLE III—DAN Scores Before and After Heel Prick (± 2 SD)

Mean pain score	EBM	Sucrose	Water	NNS	Massage	Rocking	P value
BEFORE	0.83(0.12)	0.410(.17)	0.87(0.11)	0.350(.17)	0.412(.44)	0.29(0.15)	NS
At 30 sec	9.4(1.1)	7.6*(14)	9.5(1.2)	8.8(1.1)	9.9(1.9)	9.2(0.99)	<0.05
At 1 min	5.7(1.7)	4.9(1.9)	6.7(2.7)	4.6(1.8)	5.8(2.6)	4.5(1.7)	NS
At 2 min	2.2(1.3)	2.1(1.1)	3.3(1.8)	1.4*(1.2)	2.7(1.2)	1.1*(1.4)	<0.05
At 4 min	0.89(.22)	0.7(.9)	0.8(0.12)	0.3*(.19)	0.5(0.76)	0.1*(.35)	<0.05

* Significant difference.

TABLE IV—Time of First Cry and Total Duration of Cry in Different Groups

Mean duration of cry (secs) Mean \pm 2 SD	EBM	Sucrose	Water	NNS	Massage	Rocking	P value
First cry	39(12)	33(09)	38(23)	35(12)	45(24)	36(15)	NS
Total cry	87(23)	79(16)	98(16)	43(11)*	96(25)	56(16)*	<0.05

* Significant difference.

stimulus. States of arousal >2 were associated with longer duration of cry (Fig. 2) as compared with states 1 and 2.

Discussion

Our study was a randomized, partially blinded study to compare the analgesic effects

of common, non-pharmacological methods to reduce pain in neonates. Complete blinding was not possible as many of the interventions had to be continued during and after the painful stimulus. A number of studies have compared the effects of sucrose with other non-pharmacological methods of pain assess-

Key Messages

- Rocking or giving a baby a pacifier are effective analgesics for the pain of heel pricks in stable, term neonates.
- Calming a baby into a sleeping state before a painful procedure may also decrease the response to pain.

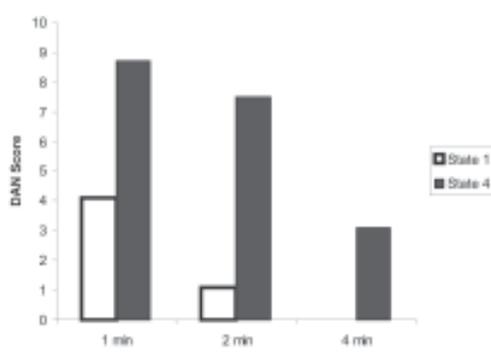


Fig. 1. DAN pain scores and state of arousal.

ment(6,7). The Cochrane analysis suggests that sucrose is better than placebo in reducing the effects of painful stimuli(8). Some studies have found sucrose to be superior to EBM(9). Carbajal *et al*(10) have shown that pacifiers alone are better than sucrose(10). Other studies have shown that multimodal stimulation is better than just sucrose(11). Rocking and pacifiers (NNS) have been compared and both have been found to reduce crying(12). Studies have also shown that NNS reduces the stress of pain(13). Our study showed that rocking or NNS were more effective than DW, EBM, massage or sucrose in reducing the DAN score at 2 and 4 minutes after the painful stimulus. Breast-feeding has been found to be analgesic and this is probably due to the multimodal stimulation that a neonate experiences when suckling from the breast compared to EBM alone(14). An interesting finding in our study is that state of arousal of the baby at the time of the painful stimulus was found to affect pain scores with babies in the sleep state (states 1

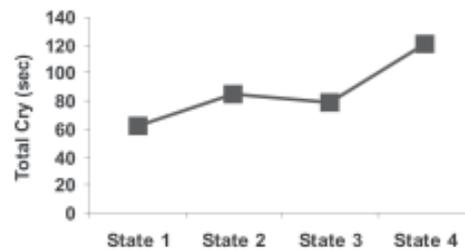


Fig. 2. Crying and state of arousal at time of stimulus.

and 2) showing lower scores and a shorter duration of crying as compared to those in higher states (states 3,4). Some other authors have also reported similar findings(4,15).

In conclusion our study suggests that rocking or giving a baby a pacifier are effective analgesics for the pain of heel pricks in stable, term neonates. Calming a baby into a sleeping state before a painful procedure may also decrease the response to pain.

Contributors: SM conceived, designed and supervised the study, NN did the DAN scores and compiled the data, RL did the assessment of crying and helped in the collection of data and logistics. SM will act as guarantor for the manuscript.

Funding: None.

Competing interests: None.

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